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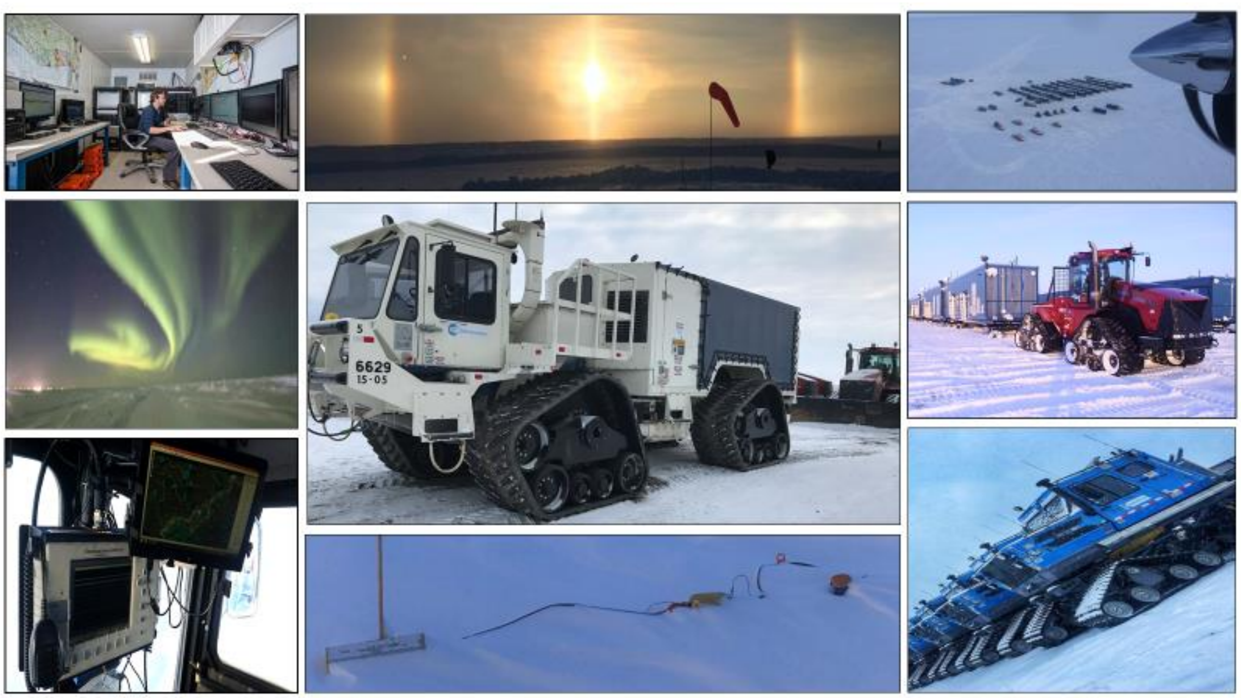
Christopher Latty
US Fish and Wildlife Service
Arctic NWR
101 12th Avenue
Room 236
Fairbanks, AK 99701
cell 907-347-4300

Marsh Creek 3D

PLAN OF OPERATIONS
WINTER SEISMIC SURVEY

Submitted by:

SAExploration, Inc.
8240 Sandlewood Pl- Suite 102
Anchorage, AK 99507



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Marsh Creek Plan of Operations

Winter Plan of Operations 2018 Project Description

1.0 Introduction

SAExploration, Inc (SAE), along with our partners, Arctic Slope Regional Corporation (ASRC) and Kaktovik Iñupiat Corporation (KIC), is pleased to submit their plan of operations for the Marsh Creek 3D Program. Together ASRC, KIC, and SAE, through its joint venture with the Kuukpik Corporation (Kuukpik-SAE), are in the process of forming a joint venture, Iñupiat Geophysical Partnership, LLC. SAE is requesting permits on behalf of its partners to conduct a seismic survey within the 1002 Area of the Arctic National Wildlife Refuge (ANWR) beginning during the winter season of 2018-2019 initially. SAE will be the operator conducting seismic operations during open tundra travel winter season within this boundary with an estimated start date of December 10th, 2018 with ice checking and continuing until the close of tundra or the sea ice deteriorates. Land ownership within this boundary area is primarily federal lands that fall within the Arctic National Wildlife Refuge 1002 area, Native Corporation land owned by ASRC and KIC, and private lands all within the North Slope Borough.

2.0 Scope

SAE is proposing to acquire seismic data from within ANWR with the opening of the coastal plain area (1002) for oil exploration. SAE would like to be the entity that initiates the exploration phase of the 1002 Area, this area represents the interests of the people of the local communities. SAE will use the best available technology, to acquire better quality and higher resolution seismic data, using new recording methodology to image potential targets for future lease sales. SAE would support two (2) crews each winter season for two (2) winter seasons to complete the acquisition of the seismic program. This plan of operations will cover the winter seasons of 2018-2019 and 2019-2020, starting approximately December 1st each winter season and ending on May 31st, or tundra closure.

3.0 Location

The survey permit area encompasses approximately 2602 sq. miles. The project area will include parts, or all the following townships:

<u>All of:</u>
U003N034E, U003N035E, U003N036E, U004N031E, U004N032E, U004N033E
U004N034E, U004N035E, U004N036E, U004N037E, U005N024E, U005N025E
U005N026E, U005N027E, U005N028E, U005N029E, U005N030E, U005N031E
U005N032E, U005N033E, U005N034E, U005N035E, U005N036E, U005N037E
U006N024E, U006N025E, U006N026E, U006N027E, U006N028E, U006N029E
U006N030E, U006N031E, U006N032E, U006N033E, U006N034E, U006N035E

U006N036E, U006N037E, U006N038E, U007N024E, U007N025E, U007N026E U007N027E, U007N031E, U007N032E, U007N033E, U007N034E, U007N035E U007N036E, U007N037E, U008N025E, U008N026E, U008N033E, U008N034E U008N035E, U008N036E,

Part of:

U009N024E, U009N025E, U009N026E, U009N032E, U009N033E, U009N034E U009N035E, U009N036E, U008N024E, U008N027E, U008N028E, U008N030E U008N031E, U008N032E, U008N037E, U008N038E, U007N023E, U007N028E U007N029E, U007N030E, U007N038E, U007N039E, U006N023E, U006N039E U006N040E, U005N023E, U005N038E, U005N039E, U005N040E, U004N038E U004N039E, U003N037E, U003N038E

The program areas are defined by the enclosed boundary map in Appendix A.

4.0 Environmental Management

This partnership is dedicated to minimizing the effect of our operations on the environment. We are unified in a commitment to environmental excellence and continuous improvement. We will constantly assess our impact on the environment, and will apply what we have learned over the past several years to each new project.

"Environmental management is not just the job of a few specialists - it is a crucial and integral part of our day-to-day business and an environmental culture for our seismic projects." Our experience on the tundra and sea ice has enabled us to manage and develop equipment and procedure to minimize environmental impact caused by seismic operations. This type of health, safety and environment (HSE) management has enable us to successfully implement many environmental improvements a few are listed below:

- Reduce the number of equipment on the tundra, through new technology, thereby has reduced the total environmental impact of the crew.
- The use of articulating, rubber tracked, low ground pressure vehicles has minimized the compaction of the tundra and risk of damage when vehicles are turning.
- Reduced vehicle size
- Many modifications of seismic equipment have minimized the risk of hydrocarbon spills to the tundra.
    - Containments systems
    - High resolution rear mounted vehicle monitoring cameras, aids in spill detection.
    - Daily and weekly maintenance of equipment.
    - Daily equipment inspections.
    - Hourly equipment walk-arounds.
    - The use of biodegradable, environmentally sensitive products is number one priority when operating in delicate regions such as the NPRA and ANWR. This includes lubricants, hydraulic fluids, greases and glycol that

have readily biodegradable based oils that are virtually non-toxic, still delivering maximum protection to our equipment aiding in preventing breakdowns.

5.0 Cultural Interface

SAE will coordinate its seismic activities with the local communities and villages to mitigate and to prevent potential conflicts when operating in close proximity of subsistence users. Prior to the commencement of the 2018-2019 and 2019-20 winter seasons, representatives will hold a meeting with the village of Kaktovik to discuss the planned activities. These discussions will include text and visual documentation of the crew's activities, as well as the project boundaries. It is anticipated that as a result of these meetings various protocols and procedures can be developed and implemented which will allow both subsistence and exploration activities to co-exist with respect to this project. Any subsistence hunting and fishing that will be in the area of operations can be documented at this time with the help of community members. All meetings will be documented and kept on file as a resource during and after activities. We are dedicated to enhance, sustain and develop locally based economic and employment opportunities for Borough businesses and residents.

6.0 Oversight Panel

An oversight panel for subsistence and the native community of Kaktovik will be developed to address subsistence issues and will report back to the communities near the project area and the agencies overseeing the project. This oversight panel will have the charter for the following:

- Meet with the Kaktovik Native Community prior to the season start to discuss the concerns.
- Document past subsistence activities in the area.
- Work with a biologist hired by SAE on any wildlife or environmental issues.
- Conduct scouting with a local subsistence representative from the community.
- Staff a subsistence observer on each crew-each shift to scout with the survey team and consult on any unknown subsistence or cultural sites.
- Address any key issues with communities.
    - "An issue is a significant opportunity, problem, factor or trend or a challenge to our mission, direction, way of doing business, or culture".

7.0 Crew Integrity

SAE's commitment at all levels to continue "Raising the Bar" for HSE awareness is paying off. Our health and safety goal is to achieve a zero-accident rating consistently. Over the past six seasons and more than 4,769,424 man hours we have not recorded a lost time accident. We attribute a portion of this success to the following critique:

7.1 Our Hiring Process:

- We work to attract and hire the best in the industry to operate the crew.
- A comprehensive pre-employment screening for new hires.
- Prospective employees are administered a drug and alcohol screening test.
- Prospective employees must complete a Physical exam and Functional Capacity Exam.
- Prospective employees complete an eight-hour Health, Safety and Environmental orientation and task specific training as well as a competency assessment while on the crew.

7.2 Our Training Process:

- The operations are controlled with high quality, experienced arctic personnel.
- Provide unique employment opportunities for its employees.
- Engages its employees in operations outside the seismic sector.
- Holds an Annual HSE Seminar for the full crew.
- Comprehensive online SAE training and testing.
- Hold daily orientation and safety briefings (for each shift) accounting for: hazards which could be encountered, other conflicting operations, daily conditions, and review of the day before and the day ahead.
- Tailgate meetings are held to review procedures in areas of known hazard or where operational requirements have changed from those expected.
- Annual training for employees, including:
  - Remote medicine training
  - Arctic survival training
  - first aid/CPR
  - Hazard recognition, rating and mitigation seminars
  - NSTC refreshers
  - Hazwoper training
  - Hazcom awareness training
  - Behavior based safety awareness training
  - Wildlife interaction training
  - Permit stipulation reviews

8.0 Permit Requirements

Provided below is a list of permits, approvals, authorizations and supporting documents required for the operations described in this Plan. Land ownership for this program includes Federal, Native Corporation (ASRC and Kaktovik Iñupiat Corporation) and private holdings all within the North Slope Borough.

Agency	Authorization
Federal Government	
Bureau of Land Management	Geophysical Exploration Permit
US Fish and Wildlife Service	Incidental Harassment Authorization (IHA), Polar Bear
North Slope Borough	
Planning Department	Land Management Development Permit for seismic: Landing Strips: Mobilization Route
IHLC Department	Form 600
TLUI Department	Administrative Approval form 400
ICAS Department	Coordination
State of Alaska	
Alaska Department of Natural Resources, State Historic Preservation Office	Letter of Concurrence
Department of Natural Resources, Division of Mining Land and Water	Temporary Water Use Permit (if necessary) Tundra Travel Permit
Alaska Department of Environmental Conservation	Kitchen Potable Water Permits Discharge Permits
State of Alaska Fish and Game	Fish Habitat Permit Water Withdrawal Permit (if necessary)
Other Approvals	
Lease Holders	Letter of Non-Objection
Kaktovik Inupiat Corporation	Letter of Non-Objection
Arctic Slope Regional Corporation (ASRC)	Letter of Non-Objection
Native Allotments	"No go buffers" placed around lands.

9.0 Mobilization and Access

SAE will stage equipment from existing facilities in Deadhorse. Camp and equipment will be trucked via road infrastructure to a point of access to the tundra or sea ice (See Appendix C). The crews will mobilize to existing gravel pads which will allow access to the tundra and provide a resupply area for the crews. All mobile equipment will have a navigation system installed for logistics and hazard Identification. Tracked and wheeled tundra vehicles will be used to transport the sled camp along the tundra. The camp will remain close to the survey activities and will move every 2-5 days depending on the survey progress and snow cover. When the survey is completed each season, the camp

and equipment will travel along the tundra or sea ice to gravel pad for offloading and then trucked back to our Deadhorse pad location. Snow packed trails will be made throughout the project area, these trails will be used for the purpose of less environmental impact and crew travel /re-supply. The location of these trails will depend on snow coverage and terrain conditions. SAE will attempt to coordinate with companies to use any existing or planned trails.

10.0 Survey and Ice check

Surveyors will establish survey controls by setting up a base station; controls will be set with a satellite navigation system transported by tracked vehicles. One of the highest risk potentials for arctic operations is properly verifying the integrity of the ice. This will be done by “ice checking units” consisting of a Tucker vehicle capable of supporting 24 hour operations. Snow machines may also be used for survey and ice check operations. The survey units will be equipped with ground penetrating radar systems (GPR), which are extremely accurate on fresh water. In addition, each ice check unit is equipped with battery operated ice auger which is used to verify the calibration of the GPR, measure ice depths on sea ice, or verify if depths where the GPR units cannot reach. Freeboard testing (ice stabilization) is also be conducted when working on floating ice to insure the ice has the strength to safely hold the equipment. Preliminary trails or snail trails will be established for every foot that the vibrators must travel on the sea ice, lakes or rivers, which will minimize the potential for breaking through the ice. Survey will also map each hazard that is discovered and placed into Tiger-Nav which is a navigation system that allows each vehicle to display the program area, hazards and avoidance areas.

In low snow years, snow surveys will be conducted to substantiate depths and will be recorded for equipment movement efforts

11.0 River Crossings

There may be areas where we encounter floating ice which may not safely support the weight of some equipment. In these cases, SAE will permit this activity with State of Alaska Department of Fish & Game, to apply water to increase the thickness of the ice to establish temporary river crossings. There also may be areas on rivers, streams and lakes that need to be protected with snow for traversing from tundra to ice for crossing. SAE will make snow ramps in these areas and establish that the ice is grounded or the ice is of sufficient ice depth to cross. This will eliminate any impact to river banks and or tundra.

12.0 Willow Protocol

SAE is committed to operate in a manner that all its operations or activities do not damage or affect the social, cultural or community in the areas where we work. If it is determined that willows are in the area, SAE has developed a willow protocol that ensures willow areas are mapped and defined by size. Willow areas will first be identified via aerial photos and possibly snow machines, the areas will then be placed

on maps. It is the responsibility of the survey manager to ensure that willow areas are recorded on the hazard maps and appropriate markings are in place. During the ground truthing of willows, Subsistence Representatives will be responsible for assisting in identifying sensitive willow areas and defining size. Survey will mark trials to be follow by the crews if it is determined that the area is accessible.

13.0 Recording Operations

The method of acquisition is Random Source Driven Acquisition (RSD) combined with a Compressive Sensing design. Seismic operations will be conducted utilizing rubber tracked/buggy vibrators and wireless, autonomous recording channels (nodes). Vibrators will typically operate within a distinct area proximal to each other. Vibrator source points will be located along source lines every 41.25 feet. Geophone receiver lines will run perpendicular to source lines, and both source and receiver lines are spaced approximately 660 feet apart. Geophones will be located along source lines every 165 feet. Up to 20 receiver lines could be placed on the ground at one time. Wireless nodes and geophones will be laid out by crews on foot and through the use of rubber tracked tundra travel approved vehicles. Each station will be placed individually and will be surveyed by GPS upon deployment. Upon retrieval, all GPS data is then entered into a database.

Using the RSD methodology, multiple vibrators can collect data at the same time. This methodology means that only a single vibrator is required to travel down any source line, thereby reducing risk compaction or damage to the tundra. Vibrators will only operate on snow covered tundra or grounded sea ice.

Recording Operations continue for 24 hours per work day and are based on two 12 hour shifts. Communications with the crews while out in the field will be via VHF radio systems and wireless data transfer radios.

14.0 Camp Facilities

Each camp can accommodate up to 150 - 160 persons. Equipment included at camp stations will include long haul fuel tractors, remote fuelers, water maker, incinerator, resupply and survival sleigh, tractors, loaders and tuckers.

Sanitary conditions in the kitchen and diner and washrooms will be maintained in full compliance with governmental regulations.

Grey water will be filtered to meet the discharge requirements of the Alaska Department of Environmental Conservation (ADEC) Alaska Pollutant Discharge Elimination System (APDES) permit prior to discharge. SAE holds a current APDES discharge permit for this purpose.

Due to the size of the project, SAE may use 2 camps and 2 crews at different locations within the project area for logistical purposes. The mobilization of the camp or camps will be from the existing gravel roads, starting off a gravel pad. A pre-determined route will be used to move equipment to the project location. Camp trails during project will be scouted out in advance by project manager to avoid hazards and measure snow depth. To mitigate any tundra damage the sleigh camp could be moved up to 2 miles every few days, this will depend on the weather, snow covering and the advancement of the project.

The SAE HSE advisor and the local hire subsistence representative will revisit every camp site, after camp has moved on, to review the area and sign-off that no damage occurred.

During the active work season, crews will travel to the camp area by personnel carrier tundra travel. If existing airstrips are within the project area those area may be utilized to allow personnel, food and fuel to be delivered to the work area.

15.0 Water Withdrawal

Potable water will be produced at camp with a skid-mounted snow melter. Water is produced by melting snow or if it is a low snow year this can be supplemented by withdrawing water from lakes, it is then processed through our ADEC approved water system. SAE will identify lakes and will be permitted if used. If lakes are used, SAE has fish and game approved water withdrawal pumps that will be utilized during this process. If there is not an adequate source of snow, water may need to be transported to each camp from an approved source.

16.0 Temporary Snow Airstrips

The project will need airstrips to transport crews on crew change days. Having temporary airstrips will save several hours of tundra travel. SAE will create a flat area on predetermined grounded, frozen lakes, or tundra to serve as landing strip to receive the aircraft for crew changes. An advance scouting trip will be identifying grounded lakes and or tundra locations that can be used for this purpose. The landing strip will only be on areas that have adequate space for safely landing aircraft. On lakes, a rubber tracked Steiger with a blade will clear the snow down to ice approximately 75 feet wide and 2300 to 3500 feet long for the aircraft to land. Black bags filled with snow will be placed along the side of the berm to delineate the edge of landing strip along with lighting.

After crew has mobilized and initial scouting has been done lakes which may support this operation will be documented for possible airstrip locations. The GPS location of the landing strip will be documented.

The strips will be used for landing and will not be maintained unless the same location is needed again. After use of the strip is no longer necessary, the crews will inspect the location and record that area that was used by GPS location to be included in the final reporting. An example of airstrip is listed in Appendix E.

17.0 Fuel Supply and Storage

SAE will be using long haul sleigh tanks for fueling. All fuel will be ultra-low sulfur for vehicles and equipment. Fuel will be delivered using over land Rolligon or rubber tracked carriers. In the event the supply is disrupted by weather or other unforeseen events fuel may have to be delivered by aircraft, SAE will use temporary airstrips for these occasions. An advance scouting trip will assist SAE in identifying existing airstrips if any that can be used for this purpose. Off-loading fuel from aircraft will be done in accordance with SAE's fueling procedure. Fueling storages and fueling activity will be located at least 100 feet from any water body. All equipment fuel locations will be tracked and recorded. SAE fueling procedures include spill management practices such as drip plan placement under any vehicle parked and placement of vinyl liners with foam dikes under all valves or connections to diesel fuel tanks. All fuel tanks are double-wall tank construction. Fuel dye is added to all fuel as part of spill detection. All spills, no matter what the size are tracked and cleaned up by SAE and used for spill prevention operations. We also hold a Spill Prevention Countermeasure Control (SPCC) plan for our fueling and fuel storage operations associated with seismic operations. This SPCC plan is site specific and will be amended for each new project. All reportable spills will be communicated through the proper agencies and reporting requirements.

18.0 Waste Management

Food waste generated by the field operations will be stored in vehicles until the end of the shift. The garbage will then be consolidated at camp in wildlife resistance containers for further disposal. All food waste generated in camp will also be collected and stored in the same consolidation area. A skid-mounted incinerator will be used for daily garbage waste. This equipment falls within the regulatory requirements of 40 CFR 60. This cyclonator will use on an average 1 to 2 gallons of fuel per hour while in use. The use of electricity is for the motor to the unit that maintains the air to fuel mixture. SAE will collect data to provide the required records on a calendar basis of description and weight of camp wastes burned.

Any wastes generated by seismic operations will be properly stored and disposed of in accordance with applicable permit stipulations and SAE controls. Food waste is continually incinerated to avoid attracting wildlife. Gray water generated from the mobile camp will be discharged according general permit AKG332000 and 18 AAC 83.210 and NPDES discharge limits. Toilets are "PACTO" type to eliminate "black water". Ash from the incinerator will be back-hauled to the North Slope Borough

disposal facility in Deadhorse. The sleigh camp will move approximately every two to five days depending on weather conditions. An inspection by the HSE Advisor will be done after camp has left to ensure that the area is clean of all debris.

19.0 Wildlife

Wildlife that may be in the area during the winter season are owls, ravens, arctic fox, wolverine, musk ox, and, possibly, over-wintering caribou, ringed seals, and polar bears. Grizzly bears also inhabit the general area in the project, but are likely to be inactive during the winter season. Polar Bears may be seen along the coastal areas and out on the sea ice. Although encounters with Polar Bears or Grizzly bears are unlikely, SAE and its contractors will exercise caution during the project. Should a Grizzly Bear or Polar Bear be encountered, SAE would follow the procedures as outlined in our comprehensive Wildlife Interaction Plan that is approved by the ADF&G and USFWS. Food and food waste will be kept inside vehicles while out in field. All Polar Bear sightings will be reported to the USFWS as per the authorization from USFWS. Any type of bear dens, suspected or confirmed will be reported to the USFWS or ADF&G agency personnel.

SAE will work with agencies to avoid and minimize interactions with wildlife; this includes abiding by relevant regulations and obtaining required authorizations. Our Wildlife Interaction Plan is listed in Appendix F.

20.0 Historic and Cultural Resources

SAE and its partners have commissioned a Cultural Resources Study to identify the historic and cultural resources in the program area. The Cultural Resources Study will inform SAE's activities. Cultural resources known and new that fall within the mapped area will have avoidance buffers placed around them. If required, an Archeological study will be permitted through the appropriate agencies and conducted approximately August 2018. Any known existing studies will be reviewed. SAE will not be accessing any native allotments without permission of the owners. A licensed archeologist will work with the NSB, State of Alaska and the Refuge manager to review existing records. The studies will include the use of the Alaska Heritage Resource Survey (AHRS) database, maintained by the Alaska Department of Natural Resources (ADNR) and the Traditional Land Use Inventory (TLUI) database, maintained by the NSB.

Previously recorded and any new AHRS sites will not be affected by any of the proposed seismic activities. All areas will have 500-foot buffers placed around them as a non-activity zone. These buffers will be placed in our Tiger Nav system and placed on maps to ensure no vehicles enter avoidance areas.

21.0 Communication & Supervision

The following personnel at SAE can be contacted for information during the permitting survey program are:

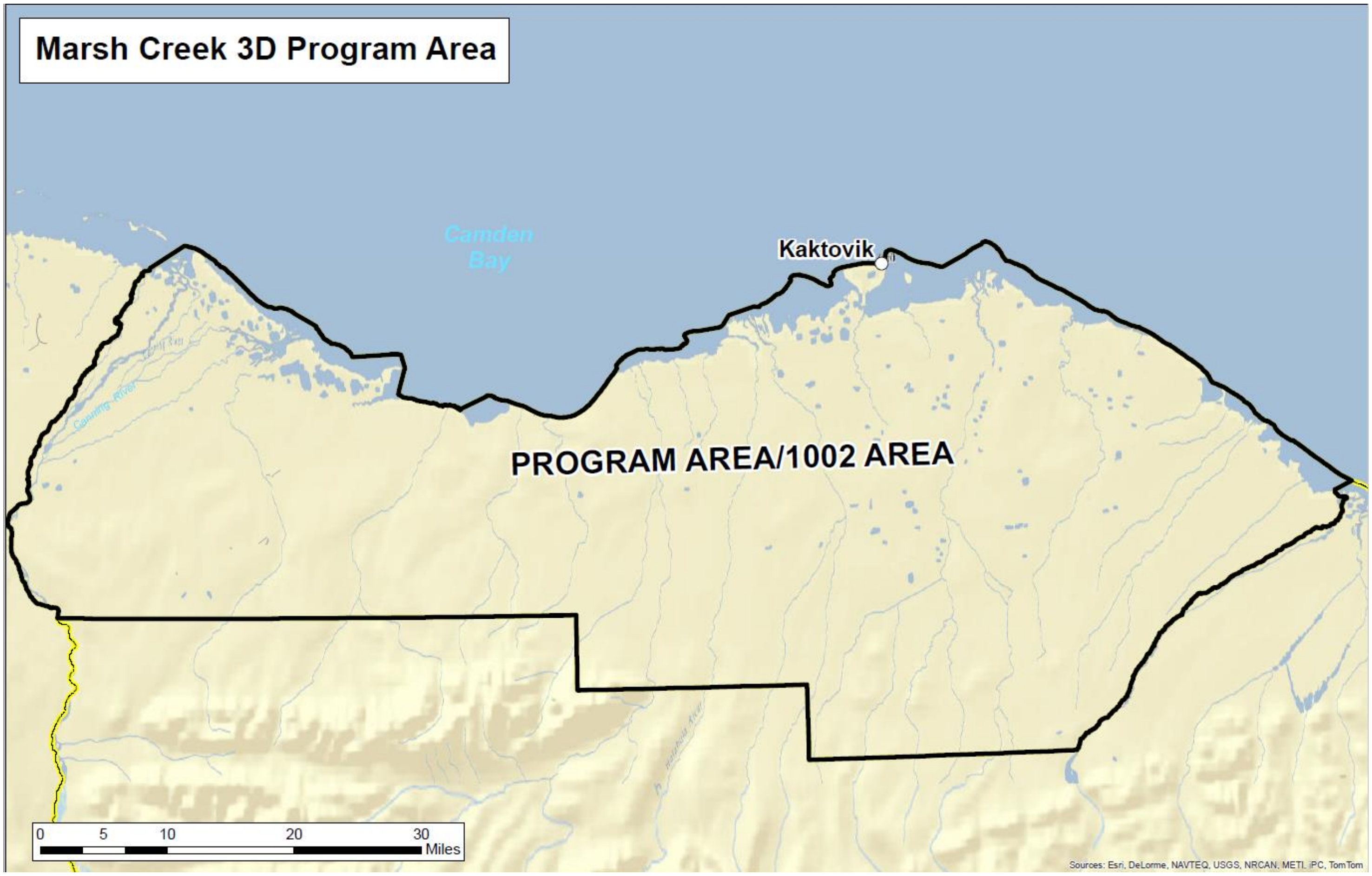
Ted Smith Operations Supervisor 907-522-4499 907-301-5434 cell
Suzan Simonds Permits and Regulatory Manager 907-522-4499 907-331-8140 cell
Rick Trupp General Manager of Alaska 907-522-4499
Oversight Panel Suzan Simonds 907-522-4499 907-331-8140

22.0 Appendices

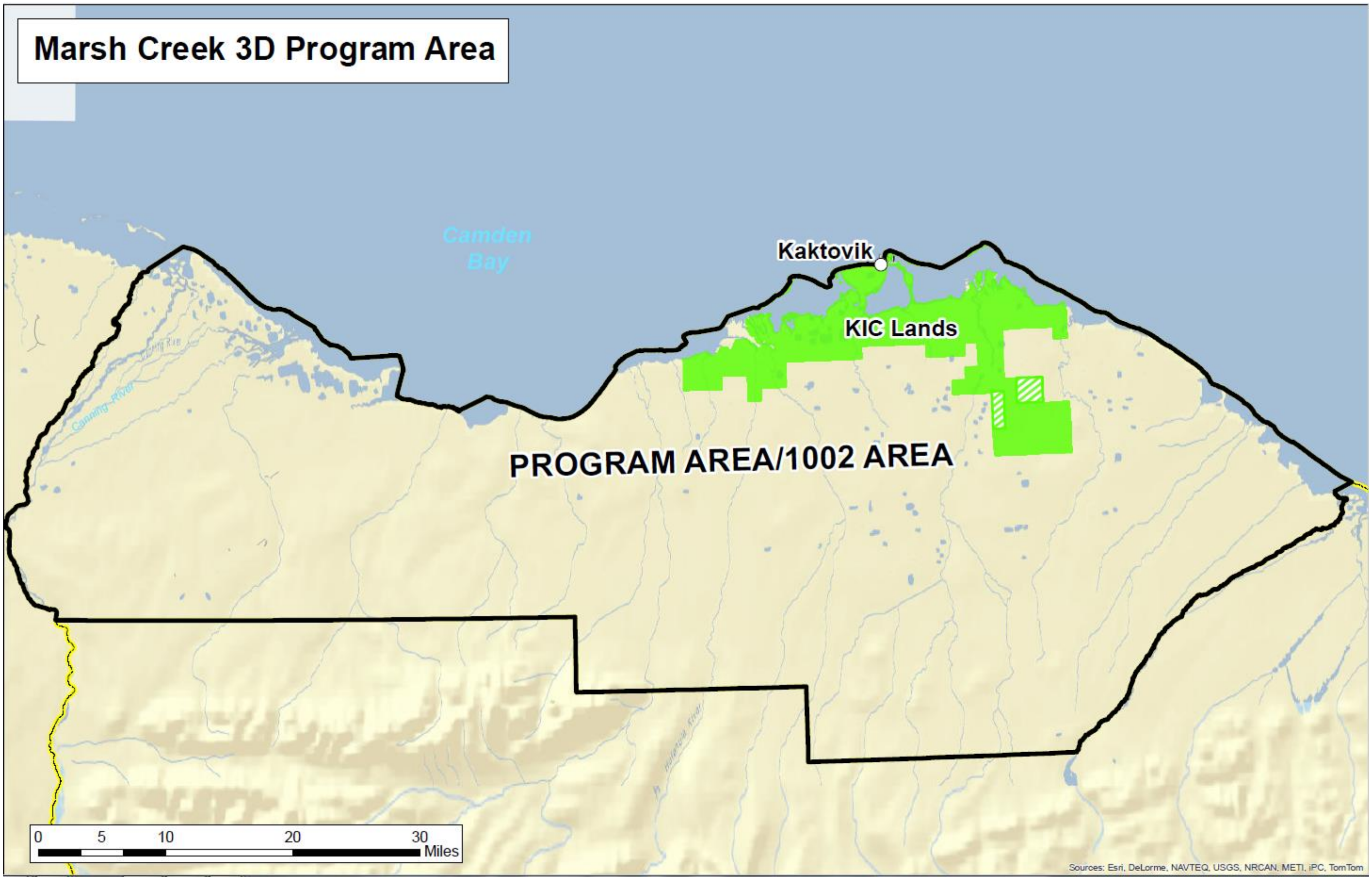
Appendix A -	Project Area Maps
Appendix B -	Equipment List
Appendix C -	Example Map of Mobilization Route
Appendix D-	Equipment Pictures
Appendix E-	Example of Temporary Airstrip
Appendix F-	Wild Life Interaction Plan

Appendix A: Project Area Maps

Project Area



Project Area with Land Status



Appendix B: Equipment List Per Crew

Equipment list per crew	Qty	Model or Similar
Crew Transportation		
Tucker Snow Cat	12	1644
Tucker Ice Cat	8	1644
Tucker Personnel Carrier	3	1600
GPS Base Station	3	Hagglund
		Trailer
Vibe Tender	2	Tucker Trailer
Mechanic Field Shop	1	Tucker Trailer
Node Charging Shack	3	Tucker Trailer
Recorder	1	Tucker Trailer
Taco	6	Trailer
Survival Trailer	2	Tucker Trailer
GSX Nodes	TBD	GSX-1
Batteries	TBD	BX10
Sensor	TBD	Arctic Base
AHV-IV Vibrators	12	Commander (PLS-364)
Crew Camp/Support Equipment		
Sleigh Camp	1	150 Man
Fuel Tanks/Fuel Stations	7	3,000 / 4000 Gallon
Long Haul Fueler	4	4,000 Gallon
Rolligons	1	
Case/Steiger Tractors	9	535
CAT Dozer	2	D7G
CAT loader	1	977H

Appendix C: Example of Mobilization Route

Appendix D: Equipment Pictures

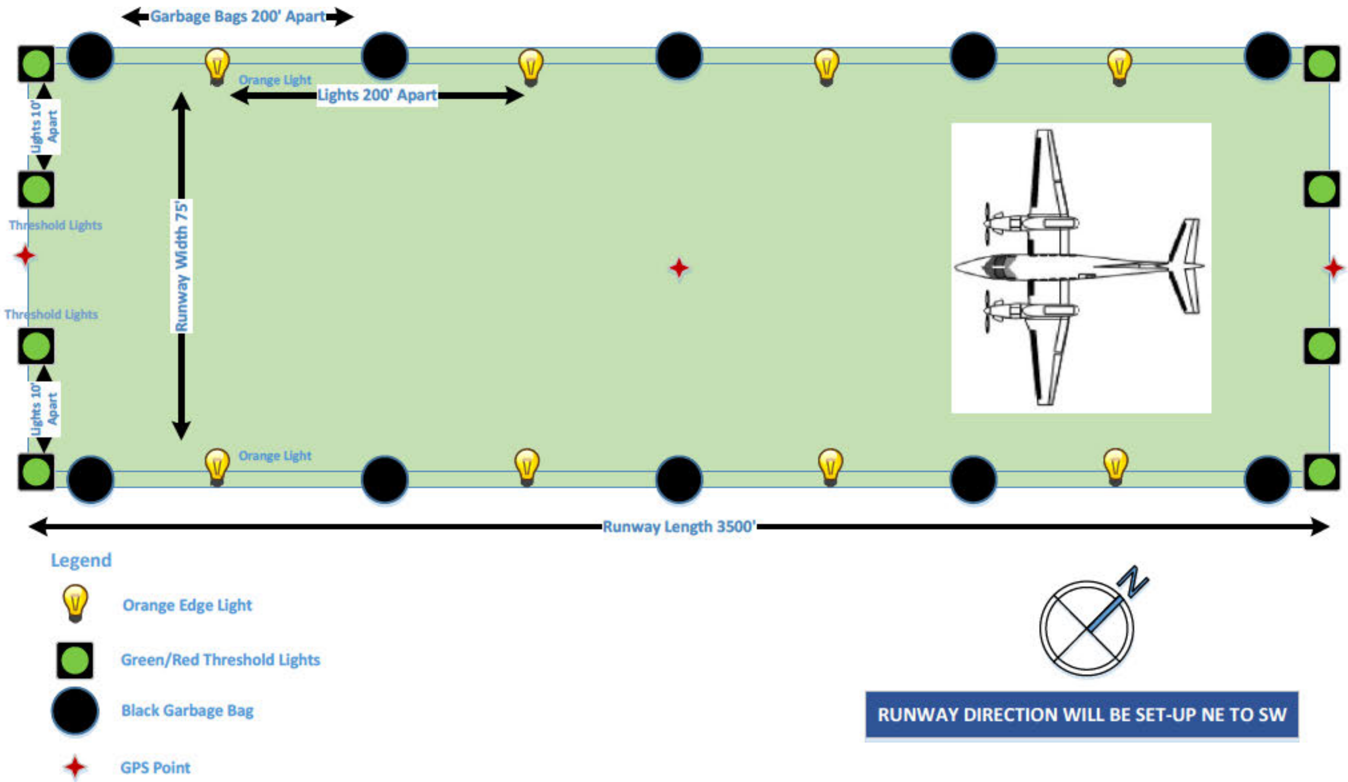
NODES
Cable-Free/Radio-Free Autonomous Data Recording
Seismic Recorder (GSX)

Tucker

Approximately 90,000 pounds with Tracks, 60,000 with tires
AHV4 Commander Vibrator (Source Equipment)

Vibe rectangular baseplate

Appendix E: Example of Temporary Airstrip



Wildlife Interaction Plan

Purpose: To provide guidelines for assuring the prompt reporting, investigation, and documentation of Polar Bears, sightings or incidents involving animals that are protected by the Marine Mammal Protection Act of 1972. This plan also covers reporting of Brown Bears, or any other wildlife that seismic crews may come in contact with during operations. This plan is intended to meet the requirement of a site specific Polar Bear awareness and interaction plan as required by 50 Code of Federal Regulations (CFR) 18.124(c)(3) and to meet the requirements for a Letter of Authorization (LOA) for the non-lethal, incidental and Non-intentional take of Polar Bear. Any permit stipulations that may be requested by permitting agencies will be added to this document as necessary.

Polar Bears: The United States Fish and Wildlife Service estimates that approximately 1,500 Polar Bears occur in the southern Beaufort Sea (SBS). Worldwide there are approximately 20,000 to 25,000 Polar Bears. During the summer months, Polar Bears typically remain on the southern edge of the sea ice. However, they are also known to swim long distances, haul out onto ice flows and barrier islands and can occasionally be found on the coast. It is expected that Polar Bears will be encountered on ice, in the water and on barrier islands,

Responsibility: The Project Manager have overall responsibility. They are responsible for coordination and implementation of all surveillance or monitoring personnel who deal with wildlife/human encounters, sightings and reporting on the North Slope.

Procedure:

Crews will be trained to maintain a constant level of awareness for the potential conflict with Polar Bears. In areas where high potential of conflict exists, SAE will evaluate and if required, place a dedicated watch for Polar Bears in the area of operations. This is not to say that a continuous watch is not always in effect but rather that the crew will have a dedicated person or persons for oversight in areas of known activity. A Polar Bear education program will be given to all workers at a pre-job conference or on-site prior to the start of operations or at commencement of employment on the North Slope. Polar Bear awareness refresher briefings will be held as part of regular safety briefings. A dedicated Health, Safety and Environment (HSE) Advisor will be based with the survey crew for the duration of the seismic program, and workers will be instructed to notify the Project Manager, or HSE Advisor immediately whenever a bear is detected. All personnel will be aware of the restrictions regarding "taking” of Polar Bears as described by the Marine Mammals Protection Act. When a bear is in the immediate area of the crew location, workers will stay inside vehicles or aircraft and away from the bear. Approaching a bear for taking pictures or any other reason is strictly forbidden. USFWS will be called

immediately.

Land based activities:

1. A polar bear den detection survey shall be conducted prior to activities occurring in polar bear denning habitat during the maternal denning period (November to mid-April). All personnel must use caution when operating near polar bear denning habitat during the denning period.

2. When a Polar Bear is detected near any part of the operation, any employee (permanent, temporary, or contract) or visitor shall immediately notify the Project Manager, or HSE Advisor. They shall then notify the Permits Manager.

3. The priority is the protection of human life. The second priority is to avoid any situation in which a bear will be harmed.

4. In a camp situation, the lead person with crew shall radio Project Manager/Administrative Office. The Administrative Office will sound the "air horn" with 5 short blasts and make a radio announcement on all crew channels of the sighting. At the sound of the air horn, EVERYONE is to go to the nearest vessel, helicopter, or vehicle and remain inside with doors and windows secured until the ALL CLEAR is given over the radio. The all clear signal is a long blast on the "air horn".

5. In the field, drivers of each vehicle will advise the personnel they are responsible for and have them get inside the vehicles and wait until further notice.

6. If the bear takes refuge near or in a vehicle and does not appear likely to move, crew HSE will be notified depending on the location of operation. No action will be taken unless authorized by the USFWS or their designated agents.

7. When a sighting is made by a standalone vehicle, such as the survey crew, they must not approach the bear further. The crew will notify the Project Manager, HSE Advisor radio to alert them. The crew must avoid the bear and if necessary cease operations until the bear has left the area.

8. Personnel must remain at least a one-half mile distance in all directions for brown bears and 1-mile distance in all directions from any known polar bear. The radio announcement must indicate whether this will be necessary or not. An all-clear signal will be sounded when the area is determined to be safe.

9. SAE must observe a 1.6 km (1 mi) operational exclusion zone around all known polar bear dens during the denning season (November-April, or until the female and cubs leave the areas). Should previously unknown occupied dens be discovered within 1.6 km (1 mi) of activities, work must cease and the Service contacted for guidance.

10. After any individual sighting or interaction with Polar Bears during operations

on the North Slope, a Polar Bear Sighting Report shall be completed by the HSE Advisor. The SAE Permits Manager will forward this report to the Office of Marine Mammals Management, Christopher Putnam 786-3810 by phone and or 786-3816 by fax, within 24 hours.

Aircraft:

1. Aircraft will not operate within 0.5 miles of Polar Bears.

2. Aircraft will avoid flying over ideal Polar Bear habitat including but not limited to sea ice and barrier islands.

3. When marine mammals are encountered, aircraft will not operate below 1,500ft unless the aircraft is engaged in marine mammal monitoring, approaching, landing, taking off, or as conditions allow.

4. Plan all aircraft routes to minimize any potential conflict with active or anticipated polar bear subsistence hunting activity as determined through community consultations.

Subsistence Hunting:

1. SAE will employ a subsistence advisor to reduce impacts on Polar Bear subsistence hunting.

2. Vessels and aircraft will avoid areas in which subsistence hunting is being conducted.

Reporting:

Polar Bears: When a Polar Bear is observed or crew member they shall immediately notify the HSE and Permits Manager who will be responsible for filling out the Polar Bear report form. Reports of sightings will be sent to the USFWS on a regular basis through the Permits Manager.

Reports will be sent to:

Christopher Putnam
USFWS-Marine Mammals Section
1011 East Tudor Road
Anchorage, AK 99503
Telephone: 907-786-3800
Fax: 907-786-3816

Brown Bears : (Ursus americanus) are the most abundant and widely distributed of the three species of North American bears.

Responsibility: The Project Manager and wilderness guides have overall responsibility. They are responsible for coordination and implementation of all surveillance who deal with wildlife/human encounters, sightings and reporting.

Procedure:

Crews will be trained to maintain a constant level of awareness for the potential conflict with bears. In areas where high potential of conflict exists, SAE will evaluate and if required, place a dedicated wilderness guides in the area of operations. This is not to say that a continuous watch is not always in effect but rather that the crew will have a dedicated wildlife guide for oversight in areas of known activity. Bear education program will be given to all workers at a pre-job conference or on-site prior to the start of operations or at commencement of employment. Bear awareness refresher briefings will be held as part of regular safety briefings. A dedicated Health, Safety and Environmental (HSE) Advisor will be based with the survey crew for the duration of the seismic program, and workers/wilderness guides will be instructed to notify the Project Manager or HSE Advisor whenever a bear is sited by use of a hazard card. When a bear is in the immediate area of the crew location, workers will stay inside vehicles or aircraft and away from the bear. Approaching a bear for taking pictures or any other reason is strictly forbidden.

1 When a bear is detected near any part of the operation, any employee (permanent, temporary, or contract) or visitor shall immediately notify the Project Manager or HSE Advisor.

2 The first priority is the protection of human life. The second priority is to avoid any situation in which a bear will be harmed.

3. In a camp situation, the lead person with crew shall radio Project Manager/Administrative Office. The Administrative Office will sound the “air horn” with 5 short blasts and make a radio announcement on all crew channels of the sighting. At the sound of the air horn, EVERYONE is to go to the nearest vessel, helicopter, or vehicle and remain inside with doors and windows secured until the ALL CLEAR is given over the radio. The all clear signal is a long blast on the “air horn”.

4. In the field, drivers of each vehicle will advise the personnel they are responsible for and have them get inside the vehicles and wait until further notice. If no vehicles are near, the wilderness guide shall lead crew away from bear.

5. If the bear takes refuge near or in a vehicle and does not appear likely to move, crew HSE will be notified depending on the location of operation. No action will be taken unless authorized by the AKFG or their designated agents.

6. The crew must avoid the bear and if necessary cease operations until the bear has left the area. The bear’s safe distance from the crew will determine by the

wilderness guide. The distance should be far enough as not to affect the bears behavior. The radio announcement must indicate whether this will be necessary or not. An all-clear signal will be sounded when the area is determined to be safe.

7. Personnel must report any active bear dens. These dens will be mapped and sent to AKFG. After any individual interaction with bears during operations, the Bear Sighting Report shall be completed by the HSE Advisor or the wilderness guide. The SAE Permits Manager will forward this report to the agencies which are listed in the permit stipulations of all permits within 24 hours.

Caribou / Foxes / Wolverines or Other wildlife:

Responsibility: The Project Manager and wilderness guides have overall responsibility. They are responsible for coordination and implementation of all surveillance who deal with wildlife/human encounters, sightings and reporting.

Procedure:

1 Avoid any interaction with wildlife.

2 Do not take any actions that would cause the animals to change course or behavior unless approved by Alaska Fish and Game

3 After any individual interaction with Caribou or other types of wildlife during operations, the Wildlife Sighting Report shall be completed by the HSE Advisor or the wilderness guide. The SAE Permits Manager will forward this report to the agencies which are listed in the permit stipulations of all permits.

4 If foxes or other wildlife take up shelter within camp area, notify the permits manager.

5 Feeding of animals is strictly prohibited.

6 There is no hunting or fishing allowed on project.

U.S. Fish And Wildlife Service
Marine Mammals Management
POLAR BEAR SIGHTING REPORT

Company: ________________________ **LOA #:** __________________________
Date: ____________________________ **Observer Name:** ___________________
Time: _________________ am / pm / 24 **Phone/Email:** ______________________

Location: ____
____

Latitude: __________________ **Longitude:** ___________________ **Datum:** __________

Weather Conditions: Fog____ Snow____ Rain____ Clear____ Temperature____°F / °C

Wind Speed____ mph / kts Wind Direction (from) ____ N NE E SE S SW W NW

Visibility: Poor____ Fair____ Good ____ Excellent____

Total Number of Bears: _______ (total number of bears & how many of each type)

	adult	sub-adult	2 year-old	yearling	cub of year
Male	____	____	____	____	____
Female	____	____	____	____	____
Unknown	____	____	____	____	____

Closest Distance of Bear(s): from personnel________ facility/vessel________ m / yd / ft

Bear Behavior (Initial Contact): curious ignore aggressive walk run swim hunt feed rest other
____

Bear Behavior (After Contact): curious ignore aggressive walk run swim hunt feed rest other
____

Description of Encounter: ____
____
____
____

Duration of Encounter: ______________ **Possible Attractants Present:** Y / N

Describe Attractants: ____

Deterrents Used & Distance: If Yes, submit report within 48 hours of incident

Vehicle Y / N ___ m / yd / ft ______ Spotlight/Headlight Y / N ___ m / yd / ft ___
Horn/Siren/Noise Y / N ___ m / yd / ft ______ Other (describe) Y / N ___ m / yd / ft ___
Crackershell Y / N ___ m / yd / ft ______ ______________________________
Rubber Bullet Y / N ___ m / yd / ft ______ ______________________________
Bean Bag Y / N ___ m / yd / ft ______ ______________________________

Report Sent To: FW7_MMM_REPORTS@FWS.GOV Date: ____________ Time: ________

For further information contact USFWS Marine Mammal Office: 907-786-3800 or 1-800-362-5148

Jack Winters
Habitat Biologist
Division of Habitat
Department of Fish and Game
1300 College Road
Fairbanks, Alaska 99701
907-459-7285

Date:_________
Time:_________

Bear Interaction Report

Location:____
____

Observer name: ____

Weather conditions: Fog ___ Snow ___ Rain ___ Clear ___ Wind Speed ___
Wind Direction ____ Approx. Temp ___

Total number of bears: ___ Sow/cubs __/__ Adult ___ Subadult ___

Estimated distance of bear from personnel/facility: _____/_____

Possible attractants present: ____________________________

Bear behavior: Curious ___ Aggressive ___ Predatory ___ Other ___

Description of encounter:____
____
____
Injuries sustained: Personnel ___________________________

Bear ___________________________

Deterrents used/distance: Vehicle ___ Noise-maker ___ Firearms ___
Other ___
Duration of encounter: ______
Agency Contacts: _____________________Time:_____Date:______
ADF&G__________________Time:_____Date:______
SAE___________________Time:_____Date:______

SAE Representative:____________________________________Date:_________

Jack Winters
Habitat Biologist
Division of Habitat
Department of Fish and Game
1300 College Road
Fairbanks, Alaska 99701
907-459-7285

Date:_________
Time:_________

Wildlife Sighting Report

Location: ____
____

Observer name: ____

Weather conditions: Fog ____ Snow ____ Rain ____ Clear ____ Wind Speed ___
Wind Direction ____ Approx. Temp ___

Total number of animals: ___ Type ___ __/__ Adult ___ Subadult ___

Estimated distance from personnel/facility: _____/_____

Possible attractants present: _____________________________

Animal behavior: Curious ___ Aggressive ___ Predatory ___ Other ___

Description of encounter: ____
____
____

Injuries sustained: Personnel ____________________________

Animal ____________________________

Deterrents used/distance: Vehicle ___ Noise-maker ___ Firearms ___
____________ Other ___
Duration of encounter: _______
Agency Contacts: __________________________ Time: _____ Date: ______
ADF&G____________________Time:_____Date:______
SAE____________________Time:_____Date:______

SAE Representative: ____________________________________ Date: _________

Field Operating Procedure
Polar Bear Protocol

Purpose: To provide guidelines for assuring the prompt reporting, investigation, and documentation of Polar Bear sightings or incidents involving animals that is protected by the Marine Mammal Protection Act of 1972.

Scope: This procedure applies to all sightings or interaction with Polar Bears occurring during operations on the North Slope.

Responsibility: The Project Manager and HSE Advisor have overall responsibility. They are responsible for coordination and implementation of all surveillance or monitoring personnel who deal with wildlife/human encounters or sightings on the North Slope.

Procedure:

1. A polar bear den detection survey shall be conducted prior to activities occurring in polar bear denning habitat during the maternal denning period (November to mid-April). All personnel must use caution when operating near polar bear denning habitat during the denning period.

2. When a Polar Bear is detected near any part of the operation, any employee (permanent, temporary, or contract) or visitor shall immediately notify the Project Manager or HSE Advisor.

3. The first priority is the protection of human life. The second priority is to avoid any situation in which a bear will be harmed.

4. The Administrative Office will sound the “air horn” with 5 short blasts and make a radio announcement on all crew channels of the sighting. At the sound of the “air horn, EVERYONE in camp is to go to the nearest trailer or vehicle and remain inside with doors and windows secured until the ALL CLEAR is given over the radio. The all clear signal is a long blast on the “air horn”.

5. In the field, drivers of each vehicle will advise the personnel they are responsible for and have them get inside the vehicles and wait until further notice.

6. If the bear takes refuge near, in, or under a trailer or vehicle and does not appear likely to move, crew HSE security will be notified depending on the location of operation. No action will be taken unless authorized by the USFWS or their designated agents. The District Manager and North Slope Security must be contacted at this time.

7. Areas which have been identified as possible denning sites will be avoided per the permit stipulations. (Typically, prior to mobilization, Polar Bear den locations are received and entered into our hazard mapping system.) Survey crew, trained in Polar

Bear awareness, will be responsible as the lead vehicles in the field to scout for possible additional locations and bring to the crew's attention at the daily safety meetings those locations. Possible locations will be staked in the field and entered on the hazard maps for the crew per permit stipulations. If a den is encountered protocols from USFW will be followed. Operations will then be evaluated and modifications to the operation will be implemented that will allow the avoidance of the denning site and the continuation of exploration activity.

8. When a sighting is made by a stand-alone vehicle, such as the survey crew, they must not approach the bear further. The crew will notify the Project Manager or HSE Advisor via radio to alert them. The crew must avoid the bear and if necessary cease operations until the bear has left the area. The bear's distance from camp will determine whether step 3(b) is required. All personnel must remain at least a one mile distance in all directions from any known bear dens. The radio announcement must indicate whether this will be necessary or not. An all-clear signal will be sounded when the area is determined to be safe.

9. After any individual sighting or interaction with Polar Bears during operations on the North Slope, a Polar Bear Sighting Report shall be completed by the HSE Advisor. The SAE Permits Manager will forward this report to the Office of Marine Mammals Management as listed in the plan of operations.

10. A skid-mounted incinerator will be used for solid waste incineration. All garbage that contains any food will be bagged, stored inside the facilities and incinerated on site two times per day. The resulting ash will be back hauled to the North Slope Borough disposal facility during the winter season.

11. Winter crews will be trained to maintain a constant level of awareness for the potential conflict with Polar Bears. In areas where high potential of conflict exists, SAE will evaluate and if required, place a dedicated watch for Polar Bears in the area of operations. This is not to say that a continuous watch is not always in effect but rather that the crew will have a dedicated person or persons for oversight in areas of known denning or activity. A Polar Bear education program will be given to all workers on-site prior to the start of operations or at commencement of employment on the North Slope. Polar Bear awareness refresher briefings will be held as part of regular safety briefings. A dedicated Health, Safety and Environmental (HSE) Advisor will be based at the camp for the duration of the winter seismic program, and workers will be instructed to notify the Project Manager or HSE Advisor immediately whenever a bear is detected. All personnel will be aware of the restrictions regarding "taking" of Polar Bears as described by the Marine Mammals Protection Act. Approaching a bear for taking pictures or any other reason is strictly forbidden.

12. Plan all aircraft routes to minimize any potential conflict with active or anticipated polar bear subsistence hunting activity as determined through community consultations.

Permits Manager will send reports to:

Christopher Putnam
USFWS-Marine Mammals Section
1011 East Tudor Road
Anchorage, AK 99503
Telephone: 907-786-3800
Fax: 907-786-3816

From: Latty, Christopher
To: Churchwell, Roy
Date: Friday, June 1, 2018 5:53:08 PM
Attachments: Draft affected environment_Seismic survey_EA_6-1.docx (Withheld in full b5-DP)
Species Table_5-31-18.xlsx

--
Christopher Latty
US Fish and Wildlife Service
Arctic NWR
101 12th Avenue
Room 236
Fairbanks, AK 99701
cell 907-347-4300

Migratory Birds

The U.S. Fish and Wildlife Service (2015b) lists a total of 201 migratory bird species for the entirety of the Arctic National Wildlife Refuge. The 201 species total is a cumulative number, generated over many years of observations and includes species that were only seen once and those seen frequently each year across the refuge. At least 57 species regularly occur as breeding, nonbreeding, or both in the 1002 Area (table 1). These are species recorded on the coastal plain or nearshore areas of the Beaufort Sea as “fairly common”, “common”, or “abundant”.

Table 1. List of 57 fairly common, common, and abundant breeding and nonbreeding bird species for the coast, inland, and barrier island and lagoon regions of the 1002 Area of the Arctic National Wildlife Refuge, Alaska.

[Species: Species names and order follows Chesser and others (2017). Reference: Source references used are: 1, Garner and Reynolds (1986); 2, Garner and Reynolds (1987); 3, Brown and others (2007); 4, Dau and Bollinger (2009); 5, U.S. Fish and Wildlife Service (2015b); 6, Kendall (2005). Generalized categories of abundance were used by most references since few quantitative surveys have been conducted in the 1002 Area. For Dau and Bollinger (2009), we did not include species with less than or equal to 15 average sightings per year (see table 2). In cases where habitat area is given as “coastal plain” by a reference, both coast and inland areas are included. Abbreviations: B, breeding, NB, non-breeding]

	Region within 1002 Area								
Species	**Coast**	**Inland**	**Barrier Islands and Lagoons**	**Reference**	**BMC**	**BCC (north slope) or**	IUCU status	Audobon Watchlist	Shorebird Conservation Plan Status List
Greater white-fronted goose (*Anser albifrons*)	NB	NB		1, 2, 5	X		LC		
Snow goose (*Anser caerulescens*)	NB	NB		1, 2, 5	X		LC		
Brant (*Branta bernicla*)	B, NB		NB	1, 2, 4	X		LC	Yellow	
Cackling goose (*Branta hutchinsii*)	B, NB	B, NB		1, 2, 5	X		LC	Yellow	
Tundra swan (*Cygnus columbianus*)	B, NB	B, NB		1, 2, 5, 6	X		LC		
American wigeon (*Mareca americana*)	NB			1	X		LC		
Northern pintail (*Anas acuta*)	B, NB	B, NB	NB	1, 2, 4, 5	X		LC		
Greater scaup (*Aythya marila*)	NB		NB	1, 4	X		LC	Red	
King eider (*Somateria spectabilis*)	B, NB		NB	2, 4, 5	X		LC	Yellow	
Common eider (*Somateria mollissima*)	NB		B, NB	1, 2, 4, 5, 6	X		Near Threatened		
Surf scoter (*Melanitta perspicillata*)			NB	1, 4	X		LC	Declining	
White-winged scoter (*Melanitta fusca*)	NB		NB	4, 5, 6	X		LC		
Long-tailed duck (*Clangula hyemalis*)	B, NB	B	NB	1, 2, 4, 5, 6	X		Vulnerable	Declining	
Red-breasted merganser (*Mergus serrator*)	NB	B	NB	1, 2, 4, 5, 6			LC		
Willow ptarmigan (*Lagopus lagopus*)	B, NB	B, NB		1, 2, 5			LC		
Rock ptarmigan (*Lagopus muta*)	B, NB	B, NB		1, 2, 5			LC		

Sandhill crane (*Antigone canadensis*)	NB			2	X		LC		
Black-bellied plover (*Pluvialis squatarola*)	NB			1, 2, 5			LC		Concern
American golden-plover (*Pluvialis dominica*)	B, NB	B, NB		1, 2, 3, 5			LC	Red	High Concern
Semipalmated plover (*Charadrius semipalmatus*)		B, NB		2, 5			LC		Least
Upland sandpiper (*Bartramia longicauda*)		B		5	X	X	LC		Least
Whimbrel (*Numenius phaeopus*)		NB		2	X	X	LC	Yellow	High Concern
Ruddy turnstone (*Arenaria interpres*)	B, NB	B, NB		1, 2, 5			LC		Concern
Stilt sandpiper (*Calidris himantopus*)	B, NB	B		1, 2			LC	Declining	Least
Sanderling (*Calidris alba*)	NB			2			LC	Declining	Concern
Dunlin (*Calidris alpina*)	B, NB	B		1, 2, 3	X	X	LC	Red	High Concern
Baird's sandpiper (*Calidris bairdii*)	B	NB		1, 2			LC		Least
Buff-breasted sandpiper (*Calidris subruficollis*)	B	B		1, 2	X	X	Near Threatened	Red	High Concern
Pectoral sandpiper (*Calidris melanotos*)	B, NB	B, NB		1, 2, 3, 5, 6			LC	Red	High Concern
Semipalmated sandpiper (*Calidris pusilla*)	B, NB	B, NB		1, 2, 3, 5			Near Threatened		High Concern
Western sandpiper (*Calidris mauri*)	NB			1, 2			LC	Yellow	Concern
Long-billed dowitcher (*Limnodromus scolopaceus*)	B, NB	B, NB		1, 2, 5			LC		Concern
Red-necked phalarope (*Phalaropus lobatus*)	B, NB	B		1, 2, 3, 5			LC	Declining	Concern
Red phalarope (*Phalaropus fulicarius*)	B, NB	B, NB		1, 2, 3, 5			LC		Concern
Pomarine jaeger (*Stercorarius pomarinus*)	B, NB	B, NB		1, 2, 5			LC		
Parasitic jaeger (*Stercorarius parasiticus*)	NB	NB		1, 2, 5			LC		
Long-tailed jaeger (*Stercorarius longicaudus*)	B, NB	B, NB		1, 2, 5			LC		
Glaucous gull (*Larus hyperboreus*)	B, NB	NB	B, NB	1, 2, 4, 5, 6			LC		
Arctic tern (*Sterna paradisaea*)	NB	NB	B	1, 2, 5, 6	X	X	LC	Declining	
Red-throated loon (*Gavia stellata*)	B, NB		NB	1, 2, 4, 5, 6	X	X	LC	Declining	
Pacific loon (*Gavia pacifica*)	B, NB	B, NB	NB	1, 2, 4, 5, 6			LC	Declining	
Yellow-billed loon (*Gavia adamsii*)	NB		NB	2	X	X	Near Threatened	Red	
Rough-legged hawk (*Buteo lagopus*)	NB	NB		2			LC		
Golden eagle (*Aquila chrysaetos*)	NB	NB		1, 2, 5			LC		
Snowy owl (*Bubo scandiacus*)	B, NB	B, NB		1, 2, 5			Vulnerable	Red	
Short-eared owl (*Asio flammeus*)	B	B		1, 2, 5	X	X	LC	Declining	
Peregrine falcon (*Falco peregrinus*)	NB			2	X	X	LC		
Common raven (*Corvus corax*)		NB		2			LC		
Eastern yellow wagtail (*Motacilla tschutschensis*)	B	B, NB		1, 2, 5			LC		
Common redpoll[1] (*Acanthis flammea*)	B	B		1, 2, 5			LC		
Hoary redpoll[1] (*Acanthis hornemanni*)	B	B		1, 2, 5			NA		

Lapland longspur (*Calcarius lapponicus*)	B	B		1, 2, 5	LC	Declining
Snow bunting (*Plectrophenax nivalis*)	B	B	B, NB	5, 6	LC	Declining
American tree sparrow (*Spizelloides arborea*)		B		1, 2, 5	NA	Declining
Savannah sparrow (*Passerculus sandwichensis*)	B	B		1, 2, 5	LC	Declining
White-crowned sparrow (*Zonotrichia leucophrys*)		B		1	LC	Declining

[1]Redpoll species were not differentiated in Garner and Reynolds (1986, 1987), but are split into two species here.

The only bird species listed under the provisions of the Endangered Species Act of 1973 that are known to occur in the 1002 Area are the threatened Alaska-breeding population of the Steller's eider (*Polysticta stelleri*) and threatened spectacled eider (*Somateria fischeri*). These species have populations in northern Alaska that range from 576 birds (292–859: 90-percent confidence interval [CI]) for the Steller's eider (Stehn and Platte, 2009) to an average index of 7,158 total birds (6,536– 7,781: 90-percent CI) for spectacled eiders (Stehn and others, 2013). Steller's eiders are concentrated in the western portion of the Arctic Coastal Plain near Utqiaġvik (formerly Barrow); whereas spectacled eiders are more widely distributed across the Arctic Coastal Plain. The Steller's eider is listed as a "rare visitor" and is not known to breed in the 1002 Area. However, the spectacled eider is listed as a "rare breeder" on the coastal plain of the Arctic National Wildlife Refuge (U.S. Fish and Wildlife Service, 2015), but it is not known how many nests occur annually within the 1002 Area.

Since 1986, the U.S. Fish and Wildlife Service has conducted annual aerial surveys of much of the Arctic Coastal Plain of northern Alaska to generate indices of nesting waterbird population size and trends over time (Stehn and others, 2013). However, only about one-third of the 1002 Area is currently surveyed, and what is surveyed falls within the low-density strata. Surveys within the low- density strata have far fewer transects that are farther apart and thus have little power to detect and determine trends of breeding and non-breeding migratory birds.

Bart and others (2013) used aerial and ground survey data to estimate distribution, abundance, and density of 3 groups of aquatic birds (waterfowl, loons, and grebes; shorebirds; and gulls, terns, and jaegers) across much of the Arctic Coastal Plain. They reported a west-to-east gradient of abundance and density of these 3 groups, with higher numbers in the west (National Petroleum Reserve - Alaska [NPR-A]), intermediate numbers in the central coastal plain (Prudhoe Bay), and lower numbers in the east (Arctic National Wildlife Refuge).

Kendall (2005) searched the barrier islands of the 1002 Area on foot in the summers of 2003– 2004 and documented a total of 229 common eider nests. From 1999 to 2009, during late June and early July, Dau and Bollinger (2009) conducted aerial surveys in nearshore waters and along barrier islands of the Arctic Coastal Plain, including areas within the 1002 Area, to count common eiders (*Somateria mollissima*) and other waterbirds. A summary of average numbers of the most common waterbirds counted during these aerial surveys that occurred within the 1002 Area (survey segments 22–27) is presented in table 2. Additionally, Lysne and others (2004) conducted near-shore sea duck and loon aerial surveys in late July and early August of 2002 and 2003 along the coast of the Arctic National Wildlife Refuge. The authors documented similar species to Dau and Bollinger (2009), but observed thousands more long-tailed ducks (*Clangula hyemalis*) during the surveys.

Table 2. Average number per year of the 17 most common bird species observed from 1999 to 2009 on coastal lagoon and barrier island aerial surveys within the 1002 Area of the Arctic National Wildlife Refuge, Alaska.

From: Greg Siekaniec
To: Wendy Loya
Cc: Karen Clark; Mary Colligan; Mitch Ellis; Socheata Lor
Subject: Re: DS Memo on Cooperating Agency process
Date: Tuesday, June 12, 2018 8:54:59 AM

Thanks Wendy. I read this last night and agree that the changes address what you note. A new way of conducting business.

Greg

Sent from my iPhone

On Jun 12, 2018, at 8:49 AM, Wendy Loya <wendy_loya@fws.gov> wrote:

> Hi Greg and Karen,
>
> Attached is new guidance from the Deputy Secretary on MOUs for DOI agencies working together, and it appears to make unnecessary the MOU we were in the process of surnaming for our work with BLM on the Coastal Plain Leasing EIS. I believe it is also likely applies to the Seismic EA for which we are attempting to finalize a project initiation letter.
>
> Let me know if you believe otherwise.
>
> Thanks,
> Wendy
>
> Dr. Wendy M. Loya,
> Arctic Program Coordinator
> Office of Science Applications, US Fish and Wildlife Service
> Anchorage, Alaska
> 907.786.3532 (office)
> 907.277.2942 (mobile)
>
> <DS Memo Coop Agency Process.pdf>

THE DEPUTY SECRETARY OF THE INTERIOR
WASHINGTON

JUN 11 2018

Memorandum

To: Assistant Secretaries
Head of Bureaus and Offices
Directors of State, Regional, and Field Offices

From: Deputy Secretary

Subject: Standardized Intra-Department Procedures Replacing Individual Memoranda of Understanding for Bureaus Working as Cooperating Agencies

Department of the Interior (Department or DOI) Bureaus that are asked by another DOI Bureau that is the lead agency in a National Environmental Policy Act (NEPA) review shall act as a cooperating agency based on the following parameters, and without the need for an individual Memorandum of Understanding (MOU).

Background

The National Environment and Policy Act (NEPA),[1]through the Council on Environmental Quality,[2] directs lead agencies conducting environmental reviews to include other Federal or State agencies with jurisdiction, either by subject matter expertise or by law, as cooperating agencies during a NEPA analysis. Federal and State Agencies historically formalize this relationship through the use of a MOU to clarify each agency's roles and responsibilities.

Despite residing within the same department, DOI's Bureaus have also employed NEPA cooperating agency MOUs. Intra-Department MOUs were intended to coordinate Bureau efforts and direct the deployment of resources, yet they often and unnecessarily delay environmental reviews. Accordingly, the following guidance replaces the Intra-Department MOU process with standardized guidance for efficient NEPA review and Bureau collaboration.

Directive

Intra-Department Bureaus that are asked to participate in the NEPA process[3], where another DOI Bureau is the lead Agency, and that qualifies as a cooperating agency under 42 U.S.C. § 4332 and 40 CFR 1501.6, shall act as a cooperating agency without developing an individual MOU. Instead, the agreements below should serve as their operating agreement.

---

[1] 42 U.S.C. §4332.
[2] 40 CFR 1501.6.
[3] The direction in this Memorandum applies to Environmental Impact Statements, Environmental Assessments, Categorical Exclusions, and any other form of analysis under NEPA.

Agreements

Intra-Department cooperating agency relationships shall be conducted in accordance with 40 CFR 1501.5 and 1501.6 and this section, which sets forth the Bureaus' cooperative roles in the NEPA review process:

Determination of Lead Agencies

When a project proponent or agency proposes an action as defined by the Administrative Procedure Act §704 or by 40 CFR §1508.18, lead and cooperating agencies shall be determined as soon as practicable according to 40 CFR 1501.5 and 1501.6. The lead and cooperating agency shall immediately designate a Point of Contact (POC) to represent each Bureau in Intra-Departmental consultations regarding that project or action.[4]

In executing this process, Lead Agencies shall:

a. request the participation of each cooperating agency in the NEPA process at the earliest practicable time;
b. use the environmental analysis and proposals of cooperating agencies with jurisdiction, by law or special expertise, to the maximum extent possible, consistent with its responsibility as the lead agency;
c. to the extent possible:[5]
    1. Recover costs from project proponents; and
    2. Fund major activities or analyses it requests from cooperating agencies, and include such funding requirements for NEPA analysis in project budget requests, to the extent that project proponents are not already paying for the analysis.
d. organize the NEPA review for a proposed project or action, including assigning a Senior Executive Service (SES) official to lead the NEPA review process and identifying a primary POC at each cooperating or participating agency;
e. meet with a cooperating agency at that Bureau's request;
f. prepare and coordinate Federal Register notices and filing Environmental Impact Statement (EIS) with EPA;
g. prepare the sole NEPA analysis for the project in coordination with the cooperating agencies. All NEPA analyses should include an adequate level of detail to inform decision makers regarding the environmental impacts of a proposed project or action while maintaining the Department's document and timeline standards;
h. inform cooperating agencies of new material information and changes related to the project or action;
i. review and consider comments submitted by cooperating agencies;

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[4] In instances where Bureaus are co-lead agencies, it is incumbent upon them to determine which acts as the administrative lead agency with final responsibility responsible for completion of the tasks within the Lead Agency section of this Memorandum. However, co-lead agencies shall work together to complete these responsibilities.
[5] The terms in this paragraph apply to both intra and inter Departmental NEPA analysis.

j. if required, develop the NEPA document's purpose and need, identify the range of alternatives to be analyzed, identify the preferred alternative(s), and determine whether to develop the preferred alternative to a higher level of detail;
k. provide cooperating agencies the opportunity to review and contribute to all relevant and substantive phases of the NEPA analysis and its preparation;
l. if required by One Federal Decision (OFD), prepare and publish a single Record of Decision (ROD) for all cooperating agencies responsible for the project or action to support any necessary authorization decisions. The ROD will incorporate the decisions of each such agency; and
m. maintain a contemporaneous Decision File of the information assembled and utilized by the cooperating agencies as the basis for their NEPA review.

In executing this process, Cooperating Agencies shall:

a. participate in the NEPA process beginning at the earliest practicable time;
b. participate in the scoping process, attend regularly scheduled meetings, and engage in any other activity necessary to efficiently conduct a project's NEPA analysis;
c. upon the request of the lead agency, assume responsibility for developing information and preparing environmental analyses, including portions of an Environmental Assessment (EA) or EIS with which that Bureau has special expertise;
d. review and submit comments to the lead agency on the environmental analysis performed by the lead and other cooperating agencies within the specified timeframe;
e. if required by OFD, participate in the preparation of a single ROD by providing technical drafting assistance and comments that support the underlying authorization decision;
f. compile a contemporaneous Decision File composed of all documents and communications that inform the cooperating agency's analysis, and systematically provide those documents to the lead agency; and
g. make staff support available at the lead agency's request, within the Bureau's available resources.

Dispute Resolution

a. Any disputes arising among lead and cooperating agencies in the NEPA review process shall be promptly brought to the attention of the appropriate first line SES members with authority over the project, or the office responsible for the NEPA review, and be resolved by them;
b. In the event that first line SES members are unable to resolve such disputes, the issue shall be raised to the appropriate Bureau directors for resolution;
c. In the event that Bureau directors are unable to resolve such disputes, the issue shall be raised to the appropriate Assistant Secretaries for resolution; and
d. In the event that Assistant Secretaries are unable to resolve such disputes, the issue shall be raised to the Office of the Deputy Secretary for resolution.

NEPA Timelines, Schedules, and Document Page Count

a. When conducting a NEPA analysis, Intra-Departmental cooperating agencies shall strive to meet the page count and timelines set forth in Secretarial Order 3355 by agreeing upon a timeline or schedule of milestones;
b. If a proposed project or agency action qualifies as a Fixing America's Surface Transportation Act or OFD action, then Intra-Departmental Bureaus will comply with the timelines set forth in the OFD Memorandum of Understanding;
c. To comply with agreed upon timelines, Intra-Departmental agencies shall cooperate, communicate, share information, and resolve conflicts that could prevent timely completion of the NEPA review; and
Each agreed upon project or action schedule shall be uploaded to the NEPA and Permit Database by the lead agency, and where appropriate, the Federal Permitting Dashboard, as soon as is practicable based upon the timely filing of the project or action's Notice of Intent (NOI).

Communication

Intra-Department cooperating agencies shall proactively participate in environmental reviews by communicating with one another, as well as project proponents and stakeholders, in an effective and structured manner that starts early and continues throughout the review process. Active communication will provide all cooperating agencies with the opportunity to identify concerns, raise potential issues early in the review process, and identify solutions.

Concurrent Reviews

Cooperating agencies shall carry out their obligations with respect to NEPA concurrent to the review performed by the lead agency.[6] Intra-Department NEPA reviews shall also be conducted according to the guidelines within Secretary Order 3355.

Additional Provisions

a. Nothing contained in this Memorandum is intended to or should be construed to limit or affect the authority or legal responsibilities of the Department's Bureaus, nor bind Bureaus to perform actions beyond their respective authorities;
b. This Memorandum shall be implemented consistent with applicable law and subject to the availability of appropriations;
c. Specific activities that involve the transfer of money, services, or property between or among the Bureaus may require execution of separate agreements or contracts that occur as a matter of course;
d. This Memorandum does not preclude the utilization of NEPA compliance agreements between Bureaus that were in place prior to its effective date; and

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[6] Concurrent review includes but is not limited to Section 7 review under the Endangered Species Act, Section 106 review under the National Historic Preservation Act, and other permitting activities such as coordinating Right-of-Way authorizations.

e. This Memorandum is not intended to and does not create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

Effective Date

This Memorandum is effective immediately upon distribution and shall remain in effect until revoked in writing by the Deputy Secretary.

The Heads of Bureaus and Offices are responsible for transmitting this Memorandum to the appropriate staff in the State, regional, and field offices.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

1011 East Tudor Road
Anchorage, Alaska 99503-6199

In Reply Refer to:
FWS/R7/NWRS

JUN 18 2018

Ms. Nicole Hayes, Project Manager
Coastal Plain Oil and Gas Leasing Program EIS
222 West 7th Avenue, Stop #13
Anchorage, Alaska 99513

Subject: Notice of Intent to Prepare an Environmental Impact Statement (EIS) for the Coastal Plain Oil and Gas Leasing Program, Alaska. Scoping Comments (83 FR 17562)

Dear Ms. ~~Hayes~~: Nicole

The U.S. Fish and Wildlife Service (Service) has reviewed the Bureau of Land Management's (BLM) request for scoping comments related to preparation of an EIS for the proposed Coastal Plain Oil and Gas Leasing Program.

We are pleased to be a Cooperating Agency with BLM to develop an EIS for the Coastal Plain Oil and Gas Leasing Program. We appreciate the opportunity to be a Cooperating Agency, given that the Service has managed the Arctic National Wildlife Refuge (Arctic Refuge) and its resources for more than fifty years and has knowledge, data and expertise that will be valuable during the development of this EIS.

Comments and recommendations made by the Service are provided in accordance with the:

- National Environmental Policy Act (NEPA)
- Endangered Species Act (ESA)
- Marine Mammal Protection Act (MMPA)
- Migratory Bird Treaty Act (MBTA)
- Bald and Golden Eagle Protection Act
- Fish and Wildlife Coordination Act
- Alaska National Interest Lands Conservation Act (ANILCA)
- National Wildlife Refuge System Administration Act

The Service recommends the EIS fully evaluate potential direct, indirect, and cumulative effects of all aspects of the project on marine mammals, resident and anadromous fish, species listed under the ESA, and migratory birds, including bald and golden eagles. Effects on both fish and wildlife populations and their habitats should be evaluated. The Service further recommends that all potential effects of the project on the entire Arctic Refuge be evaluated, including impacts to designated and recommended Wilderness, wild and scenic rivers, recreation, hunting and fishing, and other uses. Specific scoping issues are identified in Attachment 1.

We look forward to working as a Cooperating Agency to evaluate the effects of the various alternatives on the following purposes of the Arctic Refuge:

- *Preservation of unique wildlife, wilderness and recreational values.*
- *Conservation of fish and wildlife populations and habitats in their natural diversity.*
- *Fulfillment of international treaty obligations of the United States with respect to fish and wildlife and their habitats.*
- *Continued subsistence uses by local residents.*
- *Ensuring water quality and quantity within the refuge.*
- *Providing for an oil and gas program on the Coastal Plain.*

For questions regarding these recommendations please contact our Arctic Program Coordinator Dr. Wendy Loya at 907-786-3532 or via e-mail at wendy_loya@fws.gov.

Sincerely,

Greg Siekaniec

Regional Director

Attachment

Attachment 1: Comments Section

1) **Subsistence**

Impacts to subsistence hunters from oil and gas development can include the direct impacts of activity and infrastructure as well as changes in hunter behavior associated with avoidance of industrial areas due to personal safety or fear of contaminants. Alternatives or cooperative measures that will reduce the negative effects of oil and gas industry activity on subsistence resources harvested should be cooperatively identified with input from potentially affected people and evaluated. Stipulations and BMPs that take into consideration the contemporary hunting practices and locations where harvest occurs will help minimize the potentially long-term impacts of oil and gas development on subsistence hunters. Further, the effects of oil and gas industry activity upon exposure to contaminants and health of fish, wildlife, and vegetation used for subsistence should be evaluated. The EIS should include BMPs for baseline monitoring, and minimization of contaminant exposure to important subsistence resources.

2) **Caribou**

Caribou are an iconic figure of the Arctic Refuge Coastal Plain. They are of international importance and a significant subsistence resource throughout their range.

Of primary importance to the Service is that the EIS be based on the best available data describing long-term habitat use by the Porcupine caribou herd (PCH) of the coastal plain, including calving grounds, insect relief habitat, and migration routes. These data should be used to develop leasing stipulations that protect these critical habitats, including consideration of no leasing and/or no surface occupancy in important caribou habitats, especially calving when caribou are most sensitive to disturbance, in a manner that takes into account that the subsurface will be available for oil and gas extraction.

The Environmental Consequences section should model the effects of linear features (roads, pipelines, fences) on caribou movements, considering the migration movements of caribou into the Arctic Refuge Coastal Plain from the Teshekpuk and Central Arctic herds as well as the PCH migration routes, derived from collared caribou response to infrastructure across the Alaskan Arctic. Leasing stipulations and BMPs should be used to minimize the potential for disruption to significant movement corridors.

Because the Arctic Refuge Coastal Plain is an important resource for subsistence and sport hunting, the effects of infrastructure on access to caribou and other game should be considered across all stages of development.

3) **Polar Bears:**

The proposed action is within the range of the Southern Beaufort Sea subpopulation of polar bear, a species globally listed as threatened under the federal Endangered Species Act (ESA) in addition to being protected under the Marine Mammal Management Protection Act (MMPA). This subpopulation had an estimated population size of approximately 900 bears in 2010. This estimate represents a significant reduction from previous estimates of approximately 1,800 in 1986, and 1,526 in 2006. Although there was some evidence in the 2010 estimate that the population might be showing signs of beginning to increase, analyses of over 20 years of data on the size and body condition of bears in this subpopulation demonstrated declines for most sex and age classes.

Declining sea ice conditions in the Beaufort Sea have led to an increase in the proportion of the subpopulation coming onshore in summer and autumn (from 5.8% during 1986-1999 to 20% during 2000-2014) and a 30-day increase in time spent on land. Bears in the subpopulation are drawn to

bowhead whale remains from subsistence harvest, particularly adjacent to the community of Kaktovik, AK, where ~60% of bears coming onshore will reside in late summer/fall.

The Arctic Refuge Coastal Plain has also been documented to be an important denning area for polar bears and will likely increase in importance as the percent of bears denning on land increases with sea ice loss. Designated Critical Denning Habitat overlaps with 77% of the 1002 area of the Arctic National Wildlife Refuge. With 38% more denning habitat available in the Arctic Refuge coastal plain than in the region immediately west of the refuge, and 22% of dens for bears in the subpopulation occurring within the Arctic Refuge Coastal Plain from 2000-2010, polar bears have been shown to den in the Arctic Refuge Coastal Plain with greater frequency than expected based on available habitat.

We recommend BMPs, lease stipulations (stipulations), and impact minimization measures to reduce the effects of oil and gas industry activities upon polar bears within the Arctic Refuge Coastal Plain be developed in close cooperation with the USFWS Marine Mammals Management Office (MMM). Such BMPs, stipulations, and minimization measures should also be consistent with measures required in MMPA incidental take authorizations issued by the USFWS MMM for polar bears.

4) **Resident and Migratory Birds**

The Arctic Refuge Coastal Plain and adjacent marine waters are recognized as Important Bird Areas by the American Bird Conservancy, Audubon, and Birdlife International. At least 158 species of migratory birds have been recorded in the northern foothills, coastal plain, and adjacent marine waters. At least 57 species regularly occur as breeding, non-breeding, or both in the Coastal Plain.

Although many studies were done to address how habitat alteration may affect migratory birds near Prudhoe Bay in the 1980s-1990s, Prudhoe Bay is physically much different than the Arctic Refuge Coastal Plain. Migratory birds residing in the Arctic Refuge Coastal Plain have more limited high quality habitat. After breeding at key river deltas throughout the coastal plain, large concentrations of migratory shorebirds stage to increase fat reserves before migrating south. BMPs which minimize loss and disturbance of migratory birds should be included within the EIS.

Red-throated Loons (*Gavia stellata*) have been identified as a species of Conservation Concern by the Service, Audubon Alaska, and the Alaska Department of Fish and Game. The highest densities of Red-throated Loons are found along coastal plain deep-water lakes and adjacent marine areas, including on the Arctic Refuge Coastal Plain near Camden Bay and around Barter Island. Stipulations and BMPs should be included to minimize potential impacts associated with exploration, development, and production to this species, and other species of Conservation Concern.

Cumulative effect analyses should include the overall impacts of activities across the Arctic Coastal Plain, including Canada, as well as impacts outside of Alaska in areas where migratory birds stage and winter for 9 months of the year as described in species status reports, publications, and other scientific sources.

5) **Water Quality and Quantity and the Diversity of Aquatic Habitats and Species:**

ANILCA purposes require the refuge ensure water of sufficient quality and quantity to conserve fish and wildlife populations and habitats in their natural diversity. As can be seen on landcover maps, the hydrologic differences between the NPRA and the coastal plain are significant. Given the limited water resources in the area, the EIS will need to consider how reasonably foreseeable exploration and development practices in the Arctic Refuge may differ from NPR-A and ensure that stipulations and BMPs are included to minimize the impacts to water resources as well as vegetation, soils, and permafrost.

Water withdrawal from streams, rivers, and springs could have significant and detrimental implications to the populations and habitats of fish and wildlife including aquatic invertebrates and water quality necessary to sustain aquatic life. We recommend the EIS adopt BMPs used for the development of the NPR-A prohibiting water withdrawal from rivers at all times, with the addition of prohibiting withdrawals from springs and aufeis. We recommend that the EIS analyze river systems, springs and aufeis to establish appropriate setbacks.

Water withdrawal from lakes and wetlands during exploration and development will affect water quality and quantity and potentially have negative implications on the natural diversity of populations and habitats of fish and wildlife including aquatic invertebrates. Lakes on the coastal plain are often not connected to a larger hydrologic system. We recommend BLM analyze effects of water withdrawal and develop BMPs to ensure conservation of the natural diversity of fish and wildlife habitats and populations.

Construction of ice roads, gravel roads, and other surface disturbances have the potential to disrupt surface water hydrology, overland flow, permafrost thaw, and impact water quality. We recommend BLM analyze these disturbances and their effects related to fish passage and hydrologic processes within river corridors, lake recharge, and upland vegetation with emphasis on areas with topographic relief where ponding and drying are likely to occur. BMPs should be developed and implemented to reduce the effects of infrastructure development within flood plains, on surface water hydrology, and vegetation communities.

Springs (groundwater) provide significant year round habitat for aquatic resources. Flow paths of groundwater and spring recharge within and adjacent to the coastal plain are poorly understood. We recommend the EIS consider the effects of reasonably foreseeable development activities on groundwater flow paths, evaluate the risks associated with reinjection of hazardous wastes into subsurface aquifers, and develop stipulations for leasing to eliminate the potential of contamination to springs.

Coastal lagoons are seasonally dynamic systems providing habitat, food sources, and migration routes for a variety of fish and migratory birds. We recommend the EIS evaluate the cumulative effects of all stages of oil and gas development and north slope-wide activity on coastal lagoons, including fresh water inflow and coastal stability and identify appropriate stipulations and BMPs to minimize impacts.

6) **All Wildlife**

An important purpose of the Arctic Refuge is to conserve fish and wildlife populations and habitats in their natural diversity. ANILCA defines the term "fish and wildlife" to mean any member of the animal kingdom, including without limitation any mammal, fish, bird . . . amphibian, reptile, mollusk, crustacean, arthropod, or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or part thereof."

The EIS should consider how industrial activities within the Coastal Plain as well as the cumulative effects of disturbances across species' ranges (i.e., impacts outside of the Coastal Plain) might affect wildlife and their habitats within and adjacent to the Arctic Refuge Coastal Plain including changes in natural behaviors. BMPs should be developed and identified in the EIS that would help minimize these effects.

Because riparian willows are important overwintering habitat for moose and ptarmigan, the EIS should could include BMPs to avoid disturbance during winter operations and minimize disturbance during infrastructure development.

7) **Terrestrial Environment (Vegetation, Wetlands, Soils and Permafrost)**
Because of the proximity to the Sadlerochit Mountains and the Brooks Range, the coastal plain of the Arctic Refuge is six to eight times steeper than the coastal plain to the west where oil and gas development currently exists on state lands and in the National Petroleum Reserve-Alaska (NPR-A). The more varied terrain results in higher diversity of vegetation, soils, and permafrost including vegetation types more sensitive to disturbance, such as drier sites and tall shrubs in riparian areas and dwarf shrub tundra on slopes. Shallow ice rich permafrost is believed to be extensive in the region, which requires thick, intact organic mats and vegetation to be stable and protected from melting and subsidence (thermokarst). Permafrost may provide the majority of the structural integrity of hillsides and shorelines including stream channel banks. Protection of the underlying permafrost is also a key component for any construction design. Two seismic studies conducted in the Arctic Refuge tracked recovery for at least 15 years, showing that 10 – 20% of the camp move trails were still disturbed 15 years after exploration. This was sometimes due to ground subsidence that caused the trail to become a wetter trough.

The Service requests that the EIS include stipulations and BMPs that protect vegetation, soils, and permafrost based on analyses of all available landcover data including wetland maps, soils, and permafrost. Determination of the snow depth necessary to protect vegetation across the coastal plain should be determined by vegetation type and not physiography alone (i.e., more detailed than "coastal" and "foothills").

8) **Wilderness**
The Arctic Refuge, including the coastal plain, was initially proposed by Public Land Order 2214 (1960) as the Arctic Wildlife National Range. The three identified purposes of Arctic Wildlife National Range were the preservation of wilderness values, wildlife and recreation. ANILCA §101(b) outlines the intent "to preserve in their natural state extensive unaltered arctic tundra... ecosystems; and to preserve wilderness resource values and related recreational opportunities including but not limited to hiking, canoeing, fishing, and sport hunting, within large arctic and subarctic wildlands and on free flowing rivers…." Further, ANILCA §304(g)(2)(B) requires the Secretary of the Interior to identify and describe "the special values of the refuge, as well as...wilderness value of the refuge" when developing plans. Consistent with this wilderness preservation purpose, the Refuge's 2015 Comprehensive Conservation Plan (CCP) recommended the Arctic Refuge Coastal Plain (1002 area) for Wilderness designation because it exemplifies these wilderness qualities which provide the context within which most of the Refuge's Special Values are understood and appreciated.

The general technical report titled *Keeping it wild 2: an updated interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System* published by the U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station defines the four primary qualities of Wilderness described in the Wilderness Act. These include: (1) undeveloped - free from roads, structures, and other evidence of modern human occupation or improvements, where the land essentially retains its original character and ecological function; (2) untrammeled - essentially unrestricted and free from modern human control or manipulation; (3) natural - when ecological systems are substantially free from the effects of modern civilization; and (4) primitive or unconfined recreation in wilderness settings - characterized by freedom from management restrictions on visitor behavior. We ask that the EIS describe and evaluate impacts to these qualities for all alternatives.

Where impacts to wilderness values will be unavoidable, we recommend that impacts be minimized by implementing Best Management Practice E-20 "managing permitted activities to meet Visual Resource Management (VRM) class objectives" (DOI 2012). The Service recommends that VRM Class I be

applied in areas identified by the public and Cooperating Agencies as having important wilderness values, and strive to achieve the lowest levels of VRM change from the existing Class I character of the coastal plain while implementing the oil and gas program.

Beyond the coastal plain, we request that BLM analyze potential impacts upon the adjacent designated Mollie Beattie Wilderness area, and that it examine whether buffer zones are appropriate in order to minimize the effect of industrial activities on the Mollie Beattie Wilderness area.

9) Visitor use

The Marsh Fork of the Canning, Hulahula, and Kongakut Rivers were found Eligible and Suitable under the Wild and Scenic River Act, and were recommended to Congress for inclusion in the Wild and Scenic River System. The main stem of the Canning River was found Eligible, but not Suitable; however, the river's wildlife, fish, and cultural resources are highly valued and/or used by the public for recreation. Further, the southern border of the Coastal Plain abuts the Molly Beattie Wilderness. Iconic backcountry trips start within the Wilderness and end in the lagoons of the Arctic Refuge Coastal Plain. Consideration of conserving the wild character of the rivers is requested.

Recreation occurs on the Coastal Plain throughout the year. Although the majority of recreation occurs during the summer months, emerging uses such aurora viewing, polar bear viewing, and spring caribou hunting are occurring more and more frequently during the shoulder seasons from February through May and August through October.

Many of the potential impacts to visitors would result from changes to the view-shed and soundscape. Thus, modeling visibility and sound travel of reasonably foreseeable infrastructure and operations associated with permanent development across the diverse terrain features should be included to provide guidance on infrastructure setbacks in high visitor use areas, including river corridors.

The Service requests BLM analyze: 1) possible impacts on recreational experiences and opportunities by persistent compacted snow trails which may lead to surface ice buildup and possible impacts on flow; 2) effects to recreation opportunities by staging and exploration activities keeping in mind that recreation occurs mainly February through October; 3) effects to night sky, open landscape views, and other visual resources as they affect aurora viewing and other visitor experiences; 4) effects to soundscapes as it affects visitor experiences; 5) economic effects to commercial guides and outfitters that operate in the Coastal Plain; 6) evaluation and minimization of all effects to resources within river drainages which have been recommended to Congress for Wild and Scenic River designation as required by the Wild and Scenic River Act; and 7) evaluation and minimization of all effects to resources, which include visitor opportunities, within the Mollie Beattie Wilderness. BMPs should be included to minimize visitor use impacts.

10) Air quality:

There is currently no air quality monitoring data for the Arctic Refuge Coastal Plain. With prevailing winds from the north east in the Arctic Refuge Coastal Plain, it is likely that air quality would generally experience less impacts from existing industrial emissions from north slope development to the west except during instances when winds come in from the west.

We recommend the EIS analyze predicted changes in air quality for nearby communities, land management purposes, and visitor use. We recommend that the EIS include BMPs that prevent unnecessary or undue degradation of air quality and ensure collection and analysis of air quality monitoring data for proposed exploration and development activities.

11) Acoustic environment

Resources on the coastal plain and within the adjacent designated Mollie Beattie Wilderness known to be noise sensitive include several species of wildlife and wilderness character. People potentially impacted include residents in Kaktovik, subsistence users, and recreational visitors to both the coastal plain and the adjacent Wilderness.

Acoustic issues that should be considered in the EIS include the need for baseline (pre-development) acoustic conditions, acoustic characteristics of development-related noise sources, modeled spatial predictions of acoustic impacts, disturbance-response information for wildlife and people, and the combined acoustic and visual disturbance caused by aircraft. Because aircraft disturbance can have significant impacts on subsistence users, the Service would like to ensure the EIS includes BMPs to minimize the effects of low-flying aircraft, including altitude restrictions to protect subsistence users and wildlife, and include a requirement for aircraft use plans by lessees.

12) Hazardous materials:

A variety of hazardous materials that are generated or used during routine oil and gas exploration and production activities have the potential to affect sensitive resources including aquatic habitats, soil, vegetation, wildlife, and fish species. Oil Spill Contingency Plans or similar planning processes can minimize exposures that result from spills and routine releases of these chemicals. The adequacy of these plans can help determine the magnitude of effects, but often those plans are developed outside of and after the environmental analysis in the EIS, a flaw in the process which precludes a meaningful environmental analysis under NEPA. We recommend the proposed alternatives within the EIS contain complete lists of required plans dealing with hazardous materials and the specific procedures that will be enacted to minimize spills and other exposures.

The Service also recommends contributing information gathered for the EIS to the National Oceanic and Atmospheric Administration Environmental Sensitivity Index (ESI) map database. The ESI maps provide a concise summary of coastal resources at risk if an oil spill occurs nearby. Examples of at-risk resources include biological resources (e.g., birds and coastal lagoons), sensitive shorelines (e.g., marshes and tidal flats), and human-use resources (e.g., subsistence). When an oil spill occurs, ESI maps can help responders meet one of the main response objectives: reducing the environmental consequences of the spill and the cleanup efforts. Additionally, ESI maps can be used by planners before a spill happens to identify vulnerable locations, establish protection priorities, and identify cleanup strategies.

13) Climate

We recommend BLM conduct an analysis of climate data across the coastal plain, including temperature, rain, snow, and wind trends over the last 20-40 years to evaluate how weather and climate may affect operations and infrastructure. The eastern Alaskan Arctic may experience less snow cover and/or greater wind distribution of snow, which could affect the timing and duration of winter tundra travel. Available data include three stations on the Coastal Plain associated with the Global Terrestrial Network for Permafrost, satellite imagery (including snow on/off dates), and regional weather stations. BMPs should be developed that not only set the minimum snow depth/soil freeze depth, but route-specific monitoring protocols to account for potential higher spatial variability in snow depth due to diverse vegetation, slope, and snow accumulation conditions.

14) Cultural Resources

The Arctic Refuge CCP describes the extent of the known cultural and historic sites within the Refuge. When considering commercial activities within the Refuge's coastal plain, it is important to note that cultural resources on the North Slope are on, or near the surface of the tundra and tend to be oriented along river corridors and coastal beaches. This means that many cultural resource sites on the Refuge are vulnerable to erosion and other natural forces, and to a lesser extent, from public use of Refuge

lands and waters. Although it is known that people have used this area for millennia, especially along the river corridors and the coastline, exact locations of artifacts and/or historic or cultural sites are generally unknown. The EIS should include BMPs that require surveys for important cultural, archaeological or paleontological resources prior to any ground-disturbing activities as well as measures to protect such resources once discovered.

15) International treaties/agreements/partnerships:

The proposed action has the potential to affect resources that are covered in the following treaties, agreements or partnerships:

a) Porcupine caribou treaty with Canada;
b) Migratory Bird Treaty Act;
c) East Asian-Australasian Flyway Partnership - the U.S. is a key partner in promoting the conservation of migratory birds, some of which breed in the Arctic Coastal Plain and migrate to Asia to winter;
d) 1973 Agreement on the Conservation of Polar Bears;
e) Inuvialuit-Inupiat Polar Bear Management Agreement in the Southern Beaufort Sea;
f) Arctic Council, and its working group the Conservation of Arctic Flora and Fauna, that work to conserve flora and fauna throughout the Circumpolar Arctic.

We recommend direct, indirect, and cumulative effects to transboundary resources be identified and described for physical and natural resources with emphasis on caribou, migratory birds, and polar bears.

16) Invasive Species

The Service has developed a comprehensive list of measures that help to prevent the introduction and spread of non-native, invasive plant and animal species. Prevention is the most critical aspect of invasive species management. This is especially important along rivers and streams, which can transport invasive species into more remote areas. Unlike most of the country, the Alaska climate and poor access to remote areas previously reduced the potential for introducing and proliferating invasive species in the state. However, these barriers are no longer as effective due to a warming environment and improved access. Updated and relevant precautions will help reduce the potential for invasive species from spreading. We recommend the BLM coordinate with Service to ensure the EIS includes the appropriate BMPs that minimize the introduction and spread of invasive species into and out of project area.

17) Wildfire

Although not currently widespread, tundra fires can have a significant effect on vegetation, soils, permafrost, and water quality. The Service recommends the EIS evaluate the cumulative effects of increased human infrastructure and activities, and changing climatic conditions on the risk of wildfire ignition; and identify any BMPs that would minimize risk and determine if additional Wildland Fire Resources (initial attack resources, operating bases) and management activities are necessary.

18) Connected, cumulative, or similar actions:

We recommend BLM analyze the cumulative effects of a full oil and gas build-out scenario within the Arctic Refuge Coastal Plain coupled with the full build-out scenarios for NPR-A and the State of Alaska lands of the Central Arctic. A landscape approach is needed to ensure connectivity of habitats, especially for caribou and sufficient disturbance free nesting habitat for the millions of migratory birds that travel to the Arctic to nest each summer.

From:	Paul Lawrence
To:	Hollis Twitchell
Cc:	Stephen Braund; Liz Sears; Julianus, Erin; Hayes, Miriam (Nicole); Chad Ricklefs; Amy Lewis
Subject:	[EXTERNAL] Follow-up for Input on Subsistence and Sociocultural AE Sections of Coastal Plain EIS
Date:	Tuesday, June 26, 2018 5:26:06 PM

Hi Hollis,

We just wanted to follow-up with you regarding your input for the Subsistence and Sociocultural AE Sections of Coastal Plain EIS. We had our teleconference with BLM yesterday and have a path forward for those sections.

We do want to acknowledge that we heard the input that you gave at the agency kick-off meeting on May 3, 2018 regarding those topics and that information is already being addressed in our sections. If you would like to provide additional input on those sections, please let us know.

Thanks,
Paul Lawrence
Senior Research Associate
Stephen R. Braund & Associates
P.O. Box 10-1480
Anchorage, Alaska 99510-1480
907-276-8222 (office)
907-786-8409 (direct)
paul.lawrence@srbak.com
http://www.srbak.com/

From:	Patton, Eva
To:	Steve Berendzen; Joanna Fox; Hollis Twitchell; Arthur, Stephen; Vince Mathews
Subject:	Fwd: Invitation and Draft Agenda ~ North Slope Subsistence Regional Advisory Council to meet Aug 22-13, Utgiagvik
Date:	Thursday, July 5, 2018 6:42:58 PM
Attachments:	NSRAC Draft meeting agenda-fall2018.docx

Hello,

Hope all are having a good summer and field season.

The North Slope Subsistence Regional Advisory Council will be holding its meeting in Utqiagvik on August 22 and 23. In follow up to earlier invitation for participation in this meeting the Council would very much appreciate subsistence updates and Arctic National Wildlife Refuge overview reports and any new information you may be able to share from your moose and sheep survey work as well as updates on the Porcupine Herd. The Council has always very much appreciated your participation in person as well as the Arctic National Wildlife Refuge summary reports with nice overview and pictures of all the great work that is going on in the Refuge and engagement with local communities.

Similar to the winter 2018 meeting the BLM NPR-A staff will provide a brief update on the Arctic Coastal Plain 1002 area EIS process. You are welcomed to provide any updates from the Refuge as well if you wish. The Council may have questions - just so you are aware - 1002 discussion is not listed specifically on the agenda but again is part of the BLM NPR-A comprehensive overview and updates for the Council.

Please do let me know if you have any questions or if I can be of support for your participation in any way.

Thank you

Eva

---------- Forwarded message ----------
From: **Patton, Eva** <eva_patton@fws.gov>
Date: Wed, Jun 20, 2018 at 2:08 PM
Subject: Invitation and Draft Agenda ~ North Slope Subsistence Regional Advisory Council to meet Aug 22-13, Utgiagvik

Greetings all,

Hope you have had a good spring and good start to your summer.

I'm writing to invite your participation in the upcoming meeting of the North Slope Subsistence Regional Advisory Council. The Council will meet August 22 and 23 (Wednesday-Thursday) in Utqiagvik at the Inupiat Heritage Center.

The DRAFT agenda is attached. The primary focus of this meeting will be updates and outreach on new Federal Subsistence Wildlife regulations, development of regional subsistence fisheries research priorities for the Fisheries Resource Monitoring Grant Program, and development of the Councils Annual Report to the Federal Subsistence Board based on the regional subsistence issues of interest or concern. The Council will also hear agency reports regarding subsistence fish and wildlife management in the region as well as fisheries research and monitoring project reports.

The Council very much appreciates reports and updates from Tribes, regional non-profits and all agencies working on fish and wildlife monitoring and management and subsistence issues in the region. There is a placeholder for agency reports for Federal and State agencies, Tribal Governments, Native Organizations and Non-profits. I'll be reaching out to many of you with specific requests and invitations from the Council and confirm presentations.

There will also be an opportunity for Tribal and Public comment on non-agenda items in the morning on both days. All are welcome and encouraged to participate in the meeting. The Council is looking forward to hearing from you and your community.

Please do contact me if you would like to be included on the agenda. Participation can be either in person or by teleconference. Council Chair Gordon Brower will determine the final agenda.

If you would like written materials to be included in the meeting book we will need to receive those next week by COB June 27. We realize it is a busy season for most of you and short turn around time with an early August RAC meeting so if you have written materials that you would like to be provided to the Council in advance we can still add it as supplement along with their meeting book mailing ~ please email that to me by July 19th in time to get it in with the mailing. Otherwise as always any written information you would like to share with the Council can be sent to me via email the week prior to the meeting or you are encouraged to bring copies for the Council and public if you are attending in person.

I'll be following up with many of you in the coming weeks with any further specific requests from the Council and coordination on your presentation/participation at the meeting.

Looking forward to seeing you in Utqiagvik in August.

best regards

Eva

--
Eva Patton
Subsistence Council Coordinator

U.S. Fish & Wildlife Service
Office of Subsistence Management
1011 East Tudor Road, MS 121
Anchorage, AK 99503-6199
Tel: (907) 786-3358 Fax: (907) 786-3898
1-800-478-1456
email:eva_patton@fws.gov

--
Eva Patton
Subsistence Council Coordinator

U.S. Fish & Wildlife Service
Office of Subsistence Management
1011 East Tudor Road, MS 121
Anchorage, AK 99503-6199
Tel: (907) 786-3358 Fax: (907) 786-3898
1-800-478-1456

email:eva_patton@fws.gov

NORTH SLOPE SUBSISTENCE REGIONAL ADVISORY COUNCIL

Inupiat Heritage Center

Utqiagvik

August 22 - 23, 9:00 am ~ 5:30 pm

> **TELECONFERENCE:** call the toll free number: 1-866-864-5314, then when prompted enter the passcode: 3091862
>
> **PUBLIC COMMENTS:** Public comments are welcome for each agenda item and for regional concerns not included on the agenda. The Council appreciates hearing your concerns and knowledge. Please fill out a comment form to be recognized by the Council chair. Time limits may be set to provide opportunity for all to testify and keep the meeting on schedule.
>
> **PLEASE NOTE:** These are estimated times and the agenda is subject to change. Contact staff for the current schedule. Evening sessions are at the call of the chair.

AGENDA

*Asterisk identifies action item.

1. **Invocation**
2. **Call to Order** *(Chair)*
3. **Roll Call and Establish Quorum** *(Secretary)*
4. **Welcome and Introductions** (*Chair*)
5. **Review and Adopt Agenda*** (*Chair)*
6. **Review and Approve Previous Meeting Minutes*** *(Chair*)
7. **Reports**

   Council Member Reports

   Chair's Report

   805C Report from the Federal Subsistence Board action on wildlife proposals

8. **Public and Tribal Comment on Non-Agenda Items** (available each morning)
9. **Old Business** *(Chair)*

   a. Review FY2017 Annual Report Reply from the Federal Subsistence Board

10. **New Business** *(Chair)*

    a. Fisheries Resource Monitoring Program Priority Information Needs*

    b. Notice of Funding Opportunity for the Partners for Fisheries Monitoring Program

c. Identify Issues for FY 2018 Annual Report* ....

11. Agency Reports

(Time limit of 15 minutes unless approved in advance)

Tribal Governments

Native Organizations

Special Actions

USFWS

NPS

BLM

ADF&G

OSM..

12. Future Meeting Dates*

Confirm winter 2019 meeting date and location..

Select fall 2019 meeting date and location ....

13. Closing Comments

14. Adjourn (*Chair*)

To teleconference into the meeting, call the toll free number: 1-866-864-5314, then when prompted enter the passcode: 3091862

Reasonable Accommodations
The Federal Subsistence Board is committed to providing access to this meeting for all participants. Please direct all requests for sign language interpreting services, closed captioning, or other accommodation needs to Eva Patton, 907-786-3358, eva_patton@fws.gov, or 800-877-8339 (TTY), by close of business on August 14, 2018.

From: wendy_loya@fws.gov
To: Charles Hamilton; Gilbert Castellanos; Patrick O"Dell; Joshua Rose; Stephen Arthur; John Trawicki; Paul Leonard; Edward Decleva; Peter Butteri; Tim Allen; Catherine Collins; Randy Brown; Christopher Latty; Eric Taylor; Ryan Wilson; Hollis Twitchell; Carl Johnson; Joshua Ream; Susan LaKomski; Lynnda Kahn; Jennifer Reed; Roger Kaye; John Martin; Drew Crane; Joanna Fox; Steve Berendzen; Ted Swem; Sarah Conn
Subject: Save the Dates: Review 1002 Leasing DEIS
Importance: High

Dear FWS Arctic Refuge Coastal Plain Leasing EIS "Interdisciplinary Team" member:

Please save the dates of Aug 9-13th for your review of the Draft EIS. The window is very narrow, so we will have an organized plan for review and collating comments so we can best use your area-of-expertise in our Cooperating Agency review process. More details to come as we work with BLM on how to best provide feedback.

Please advise Wendy Loya wendy_loya@fws.gov <mailto:wendy_loya@fws.gov> and your POC below if you expect to be unavailable during this time.

FES: Drew Crane
Mig Birds: Eric Taylor
Arctic Refuge: Steve Berendzen
NWRS: John Trawicki
OSM: contact Wendy

Thank you,
Wendy

Dr. Wendy M. Loya,
Arctic Program Coordinator
Office of Science Applications, US Fish and Wildlife Service
Anchorage, Alaska
907.786.3532 (office)
907.277.2942 (mobile)

From:	Wendy Loya
To:	Joshua Rose; Steve Berendzen; Stephen Arthur; Hollis Twitchell; Joanna Fox; John Martin; Christopher Putnam; Sarah Conn
Cc:	John Trawicki; Drew Crane; Eric Taylor
Subject:	1002 Leasing EIS Cumulative Impact Information Request
Date:	Friday, July 13, 2018 5:30:45 PM

Dear Colleagues,

We would like your input on any reasonably foreseeable future actions that the Service will request be included in the cumulative impacts analysis.

A reasonably foreseeable future action is defined as a project for which there is an existing proposal, a project currently in the NEPA process, or a project to which a commitment of resources (such as funding) has been made.

I will host a discussion on Monday at 11 am, or you can send your input to me by COB on Monday July 16th via this google doc:
https://docs.google.com/spreadsheets/d/1SH5Sqiv8aJb6bjLZFAjw9O2nSdk3zjuaNxfOg_qeAq0/edit?usp=sharing

cc: POCs
Thank you,
Wendy

Dr. Wendy M. Loya,
Arctic Program Coordinator
Office of Science Applications, US Fish and Wildlife Service
Anchorage, Alaska
907.786.3532 (office)
907.277.2942 (mobile)

From:	Conn, Sarah
To:	Wendy Loya
Cc:	Christopher Putnam; Hollis Twitchell; Steve Berendzen; Joanna Fox; Joshua Rose
Subject:	Re: Invitation: 1002 Actions for Cumulative Effects Analysis @ Mon Jul 16, 2018 11am - 12pm (AKDT) (sarah_conn@fws.gov)
Date:	Friday, July 13, 2018 5:34:43 PM

Just to clarify, are we talking cumulative effects for the Seismic EA, or for the Big Leasing EIS?

On Fri, Jul 13, 2018 at 3:32 PM, Wendy Loya <wendy_loya@fws.gov> wrote:

1002 Actions for Cumulative Effects Analysis **more details »**

Dear Colleagues,

We would like your input on any reasonably foreseeable future actions that the Service will request be included in the cumulative impacts analysis.

A reasonably foreseeable future action is defined as a project for which there is an existing proposal, a project currently in the NEPA process, or a project to which a commitment of resources (such as funding) has been made.

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https://docs.google.com/spreadsheets/d/1SH5Sqiv8aJb6bjLZFAjw9O2nSdk3zjuaNxfOg_qeAq0/edit?usp=sharing

Thank you,
Wendy

When Mon Jul 16, 2018 11am – 12pm Alaska Time

Where FWS-FW7 NWRS Conference Room/Regional Office or Instant Meeting Audio #[redacted]

Calendar sarah_conn@fws.gov

Who
- wendy_loya@fws.gov - organizer
- christopher_putnam@fws.gov
- hollis_twitchell@fws.gov
- sarah_conn@fws.gov
- steve_berendzen@fws.gov
- joanna_fox@fws.gov

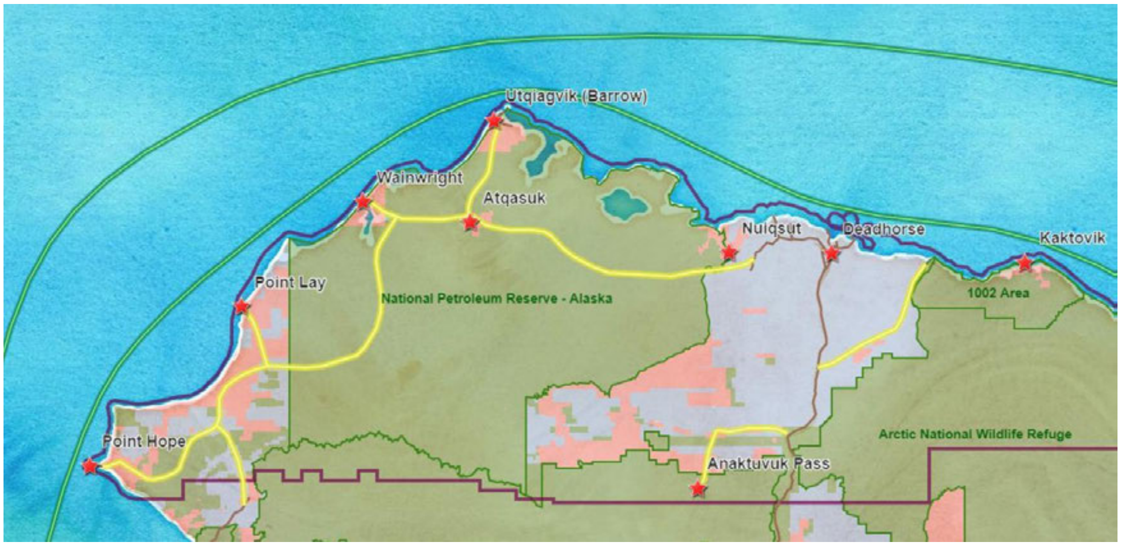
- joshua_rose@fws.gov

Going? **Yes** - **Maybe** - **No** more options »

A reasonably foreseeable future action is defined as a project for which there is an existing proposal, a project currently in the NEPA process, or a project to which a commitment of resources (such as funding) has been made.

Project Name	Location	Duration	Status	Relevancy to Arctic Refuge	Notes
Liberty Development Project	Offshore, west of 1002	Longterm	In permitting phase	marine mammals, subsistence, air quality; potentail for oil spill impacts	
Alaska LNG and/or ASAP	North Slope	Longterm	design and permitting	air quality; greenhouse gases; increased infrastructure & habitat fragmentation	Alaska LNG is planned to have a liquefaction plant on the north slope, otherwise similar.
Pt Thompson expansion	North Slope	Longterm	in progress	air quality; subsistence, caribou, polar bears; increased infrastructure & habitat fragmentation	
Prudhoe Bay	North Slope	long-term	perpetual & expanding footprint	air quality; increased infrastructure & habitat fragmentation	
Alpine Satellite Projects including TAPS lateral pipelines & linkup with Dalton Hwy	North Slope	long-term	in progress	air quality; increased infrastructure & habitat fragmentation	
Deadhorse infrastructure if not included under Prudhoe Bay	North Slope	long-term	perpetual & expanding footprint	air quality; increased infrastructure & habitat fragmentation	
Ongoing scientific research in and adjacent to 1002	North Slope	short-term but continual	in progress	studies of vegetation, hydrology, wildlife, snow, etc. Cnsidering data for NPRA (e.g. 10,000 (unverified) landings in NPRA planned in 2019)	
Aircraft associated with federal and state oil and gas operations	North Slope	short-term but continual	in progress	aircraft use associated with exploration and development (stickpicking, landscape survey)	
State leases in waters north of 1002	North Slope	long-term	exploration	marine mammals, subsistence, air quality; potentail for oil spill impacts	
ASTAR roads (see supporting info for map)	North Slope	short to long term	select implementation	subsistence (postive and negative); caribou; polar bears; water quality	http://soa-dnr.maps.arcgis.com/apps/Cascade/index.html?appid=ab8be9349a08477ebfb66d017e0aec8d

State of Alaska land, north slope leasing	Along western boundary of Arctic Refuge	long-term	exploration	air quality; increased infrastructure & habitat fragmentation especially for caribou; polar bears; subsistence; water quantity & quality; migratory birds; vegetation; fish habitat in rivers and lakes;	
existing & proposed oil & gas projects - Canada east of 1002	North Slope, Northwest Territories	long-term	ongoing & pending	caribou; subsistence	details elusive, but known to exist
Willow (CPAI in NPRA, BLM lead agency)	NPRA / Colville	long-term	early NEPA	subsitence; polar bears; air quality; water qualtiy; increased infrastructure & habitat fragmentation especially for caribou	
Nanushuk	Colville (east side)	long-term	Exploration and permitting	subsitence; polar bears; air quality; water qualtiy; increased infrastructure & habitat fragmentation especially for caribou	
Smith Bay (Large volume, coastal location, significant new infrastructure needed to develop)	Smith Bay (NW NPR-A)	long-term	Exploration	subsitence; polar bears; migratory birds; air quality; water quality; increased infrastructure & habitat fragmentation especially for caribou; oil spill impacts	
BOEM's next arctic wide (Beaufort & Chukchi seas) lease sale	Beaufort and Chukchi Seas	long-term	Lease sale pending	Marine mammals; subsistence; oil spill impacts; air quality; tourism	
Polar bear viewing	Kaktovik	long-term	in progress and expanding	socio-economic impacts; tourism	
Other activities described in AK DNR North Slope Oil and Gas Activity Map	North Slope	long-term	in progress to operations	http://dog.dnr.alaska.gov/Documents/Maps/ActivityMaps/NorthSlope/NS_ActivityMap_May2018.pdf	


Utqiagvik (Barrow)
Wainwright
Atqasuk
Nuiqsut
Deadhorse
Kaktovik
Point Lay
National Petroleum Reserve - Alaska
1002 Area
Point Hope
Arctic National Wildlife Refuge
Anaktuvuk Pass

Conn, Sarah <sarah_conn@fws.gov>

Re: Invitation: 1002 Actions for Cumulative Effects Analysis @ Mon Jul 16, 2018 11am - 12pm (AKDT) (sarah_conn@fws.gov)

1 message

Conn, Sarah <sarah_conn@fws.gov> Fri, Jul 13, 2018 at 3:38 PM
To: Wendy Loya <wendy_loya@fws.gov>

That's what I figured.

Thanks and have a great weekend (hope you get a weekend).

Sarah

On Fri, Jul 13, 2018 at 3:37 PM, Wendy Loya <wendy_loya@fws.gov> wrote:

> EIS, but we can include EA while we are at it?
>
> Dr. Wendy M. Loya,
>
> Arctic Program Coordinator
>
> Office of Science Applications, US Fish and Wildlife Service
>
> Anchorage, Alaska
>
> 907.786.3532 (office)
>
> 907.277.2942 (mobile)
>
> **From:** Conn, Sarah <sarah_conn@fws.gov>
> **Sent:** Friday, July 13, 2018 3:35 PM
> **To:** Wendy Loya <wendy_loya@fws.gov>
> **Cc:** Christopher Putnam <christopher_putnam@fws.gov>; Hollis Twitchell <hollis_twitchell@fws.gov>; Steve Berendzen <steve_berendzen@fws.gov>; Joanna Fox <joanna_fox@fws.gov>; Joshua Rose <joshua_rose@fws.gov>
> **Subject:** Re: Invitation: 1002 Actions for Cumulative Effects Analysis @ Mon Jul 16, 2018 11am - 12pm (AKDT) (sarah_conn@fws.gov)
>
> Just to clarify, are we talking cumulative effects for the Seismic EA, or for the Big Leasing EIS?
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> On Fri, Jul 13, 2018 at 3:32 PM, Wendy Loya <wendy_loya@fws.gov> wrote:
>
> > **more details »**
> >
> > **1002 Actions for Cumulative Effects Analysis**

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We would like your input on any reasonably foreseeable future actions that the Service will request be included in the cumulative impacts analysis.

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https://docs.google.com/spreadsheets/d/1SH5Sqiv8aJb6bjLZFAjw9O2nSdk3zjuaNxfOg_qeAq0/edit?usp=sharing

Thank you,
Wendy

When Mon Jul 16, 2018 11am – 12pm Alaska Time

Where FWS-FW7 NWRS Conference Room/Regional Office or Instant Meeting Audio #b5 - CIP [redacted] b5 - CIP [redacted]

Calendar sarah_conn@fws.gov

Who
- wendy_loya@fws.gov - organizer
- christopher_putnam@fws.gov
- hollis_twitchell@fws.gov
- sarah_conn@fws.gov
- steve_berendzen@fws.gov
- joanna_fox@fws.gov
- joshua_rose@fws.gov

Going? **Yes** - **Maybe** - **No** more options »

From: Wendy Loya
To: John Trawicki
Cc: Joshua Rose
Subject: FW: Requested reports
Date: Friday, July 13, 2018 12:36:00 PM
Attachments: Lyons_1987-1992_Water_resource_inventory_CoastalPlain_ArcticNWR_report_wrb_94-03.pdf
Lyons_1989_WaterResourceInventory_ArcticNWR_20275875.pdf
Lyons_1990_WaterResourceInventory_Arctic_NWR_.pdf
Lyons_1991_Water_resource_inventory_ArcticNWR_24171861.pdf
Lyons_1992_Water_resource_inventory_ArcticNWR_25933104a.pdf
Trawicki_1991_Lakesof1002.pdf
Hydrology_reports.docx
Importance: High

Hey John,

SAE has requested information on water resources, climate monitoring and the UAF snow studies for the 1002 area. Josh Rose prepared the attached documents for sharing, and the brief word doc describing the resources. Can you take a quick look and let me know if this looks good to go through BLM to SAE? I will provide the snow report memo.

Dr. Wendy M. Loya,
Arctic Program Coordinator
Office of Science Applications, US Fish and Wildlife Service
Anchorage, Alaska
907.786.3532 (office)
907.277.2942 (mobile)

From: Rose, Joshua <joshua_rose@fws.gov>
Sent: Friday, July 13, 2018 8:50 AM
To: Wendy Loya <wendy_loya@fws.gov>
Subject: Requested reports

Wendy,

Attached are the reports or links to reports requested by Donna for SAE. I did not attach the climate file because it is large and available online through the link in the citation. The word document is a summary of the hydrology reports for you and readers notes to consider including with the reports.

Let me know if you have any questions,

Thanks,
Josh

--
Joshua Rose
Acting Oil and Gas Coordinator
Arctic National Wildlife Refuge
101 12th Ave., Rm 236
Fairbanks, AK 99701

From: Trawicki, John
To: Wendy Loya
Subject: Water Reports
Date: Friday, July 13, 2018 2:46:34 PM
Attachments: Arctic_NWR_1002_Streamgage_Report_final.pdf Duplicate of : Lyons_1987-1992_Water_resource_inventory_CoastalPlain_ArcticNWR_report_wrb_94-03.pdf
Lakes of the 1002 Area AK Tech Rpt #10 FWS.PDF Duplicate of: Trawicki_1991_Lakesof1002.pdf
Tech_Rpt_6_Winet_Water_Rivers.pdf
Hydrology_reports.docx

Wendy-

Attached are the relevant reports. The lake bathymetry maps have never been compiled into a report, but exist as individual PDFs. Bayha 1996 is to large to email. It contains some biological/habitat information for each lake, but not sure it will assist SAE in their planning. All lakes also have an elevational survey that is tied to the water reservation. Lewt me know if you need anything else.

john t

--

John Trawicki
Water Resources Branch Chief
National Wildlife Refuge System, Alaska
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503
Work: (907) 786-3474
Mobile: (907) 360-1656

"The single biggest problem with communication is the illusion that it has taken place"
George Bernard Shaw

Hydrology reports:

Summary of Reports:

Lyons et al. 1989, 1990, 1991, and 1992 are all progress reports summarizing the quantification of stream discharge on multiple rivers within the 1002 area. These reports contain discharge data and no analysis is presented. Lyons et al. 1994 is a summary of the hydrologic inventory and assessment performed by the Water Resources Branch from 1987-1992. The introduction reviews the purposes of the Refuge at the time. The report summarizes multiple water resources on the Refuge coastal plain and provides a completed analysis of river discharge.

Readers note:

The reader should be aware that more than 25 years have passed since the inventory was completed. During that time technologies and methods may have changed and comparisons with more current studies should be approached with caution. Additionally, these data represent conditions at the time and may not reflect current environmental conditions within the study areas.

Lyons, S.M. 1989. Water resource inventory and assessment, Arctic National Wildlife Refuge, 1988 stream discharge gaging data. U.S. Fish and Wildlife Service, Alaska Fisheries Progress Report, Anchorage, Alaska

Lyons, S.M. 1990. Water resource inventory and assessment, Arctic National Wildlife Refuge, 1989 stream discharge gaging data. U.S. Fish and Wildlife Service, Alaska Fisheries Technical Report Number 8, Anchorage, Alaska

Lyons, S.M., and J.M. Trawicki. 1991. Water resource inventory and assessment, Arctic National Wildlife Refuge, 1990 stream discharge gaging data. U.S. Fish and Wildlife Service, Alaska Fisheries Progress Report Number 92-2, Anchorage, Alaska

Lyons, S.M., and J.M. Trawicki. 1992. Water resource inventory and assessment, Arctic National Wildlife Refuge, 1991 stream discharge gaging data. U.S. Fish and Wildlife Service, Alaska Fisheries Progress Report Number 92-2, Anchorage, Alaska.

Lyons, Steven M., and John M. Trawicki. 1994. Water resource inventory and assessment, Coastal Plain, Arctic National Wildlife Refuge, 1987-1992 final report, WRB 94-3. U.S. Department of the Interior, Fish and Wildlife Service, Anchorage, Alaska.

Trawicki, J.M., S.M. Lyons, and G.V. Elliott. 1991. Distribution and quantification of water within the lakes of the 1002 area, Arctic National Wildlife Refuge, Alaska. U.S. Fish and Wildlife Service, Alaska Fisheries Technical Report Number 10, Anchorage, Alaska.

USGS Climate report:

Readers Note:

This report presents data for air temperature, incident/reflected solar flux, wind speed/direction snow depth, atmospheric pressure, ground temperatures, soil moisture, and rainfall for 17 climate stations across the coastal plain. Four of the stations are located on the Refuge of which three are in the current area of interest. Data collection at those sites began between 2000 and 2003. Data were collected by automated stations with infrequent servicing at individual locations. Users should thoroughly read the methodology and be aware these stations by not reflect overall conditions within the project area.

I am only including the citation because the document is large and the link in the citation takes you to the USGS website where the document is stored.

Urban, F.E., and Clow, G.D., 2017, DOI/GTN-P Climate and active-layer data acquired in the National Petroleum Reserve–Alaska and the Arctic National Wildlife Refuge, 1998–2015: U.S. Geological Survey Data Series 1021, 546 p., https://doi.org/10.3133/ds1021.

WRB 94-3

WATER RESOURCE INVENTORY

AND ASSESSMENT

ARCTIC NATIONAL WILDLIFE REFUGE

1987-1992 Final Report

Water Resource Branch
Fish and Wildlife Service
U.S. Department of the Interior
Anchorage, Alaska

WRB 94-3

WATER RESOURCE INVENTORY AND ASSESSMENT,

COASTAL PLAIN, ARCTIC NATIONAL WILDLIFE REFUGE

1987-1992 Final Report

Steven M. Lyons
John M. Trawicki

June 1994

Water Resource Branch
Fish and Wildlife Service
U.S. Department of the Interior
Anchorage, Alaska

Acknowledgements:

A special thank you to Jon Kostohrys of the Bureau of Land Management for his review of this manuscript, Bob Burrows of the U.S. Geological Survey for his technical review of the field techniques and of this mauscript, and to Ken Thompson of the U.S. Geological Survey for his review of the analysis techniques.

The correct citation for this report is:

Lyons, Steven M., and John M. Trawicki. 1994. Water resource inventory and assessment, Coastal Plain, Arctic National Wildlife Refuge, 1987-1992 final report, WRB 94-3. U.S. Department of the Interior, Fish and Wildlife Service, Anchorage, Alaska.

TABLE OF CONTENTS

WATER RESOURCE INVENTORY AND ASSESSMENT

COASTAL PLAIN, ARCTIC NATIONAL WILDLIFE REFUGE

Final Report (1987-1992)

INTRODUCTION

The potential for oil and gas exploration and development along the coastal plain of the Arctic National Wildlife Refuge (Arctic NWR) has raised the issue and concern that competing uses of the limited water resources may have adverse impacts on the habitats and populations of fish and wildlife. The purpose of this study was to collect baseline hydrologic data required to quantify water resources and to aid resource managers in making sound management decisions along the coastal plain of the Arctic NWR.

Public Land Order 2214, December 6, 1960, established the Arctic National Wildlife Range by withdrawing the public lands "... for the purpose of preserving unique wildlife, wilderness, and recreational values..." to be managed by the U.S. Fish and Wildlife Service. Public Land Order 2214 was the first Federal action withdrawing lands and establishing a Federal Reserve Water Rights priority date for the Arctic National Wildlife Range. On December 2, 1980, the Alaska National Interest Lands Conservation Act (ANILCA) added 9.16 million acres to the Range and changed the name to the Arctic National Wildlife Refuge. ANILCA placed the majority of the Arctic NWR in wilderness designation. Section 1002(c) of ANILCA excluded the coastal plain of the Arctic NWR (sometimes referred to as the 1002 area) from wilderness designation for the purpose of study of the fish, wildlife and potential energy resources. ANILCA also broadened the purpose for which the Arctic NWR was established (Section 303(2)(B)) and specified that the Arctic NWR should be managed:

> (i) to conserve fish and wildlife populations and habitats in their natural diversity including but not limited to, the porcupine caribou herd... polar bears, grizzly bears, muskox, Dall sheep, wolves, wolverines, snow geese, peregrine falcons, and other migratory birds and Arctic char and grayling;
>
> (ii) to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats;
>
> (iii) to provide, in a manner consistent with the purpose set forth in subparagraph (i) and (ii), the opportunity for continued subsistence uses by local residents; and
>
> (iv) to ensure to the maximum extent practicable and in a manner consistent with the purpose set forth in paragraph (i), water quality and necessary water quantity within the refuge.

Clearly the intent of Congress was to reserve the necessary waters to protect the fisheries, wildlife and their habitats in their natural diversity.

This report is a summary of the hydrologic inventory and assessment conducted by the Water Resources Branch, U.S. Fish and Wildlife Service (1987-1992) on the coastal plain of the Arctic NWR. The U.S. Fish and Wildlife Service (1989), Lyons (1990), Lyons and Trawicki (1991, 1992, and 1993) collected and reported discharge and water temperature data for several rivers and streams in the coastal plain of the Arctic NWR for the open water seasons of 1988, 1989, 1990, 1991, and 1992 respectively. An inventory of winter water availability within river systems was conducted by Elliott (1989), and Elliott and Lyons (1990). Trawicki et al. (1991) collected depth profile measurements to determine lake volumes for 119 lakes across the coastal plain of the Arctic NWR. Under contract to U.S. Fish and Wildlife Service Global Positioning Service, Inc. (1993) surveyed the elevations of the water surface and the outer perimeter of the wet meadow zone for 150 lakes. This report summarizes the methods and results of these five projects.

PHYSICAL AND BIOLOGICAL ENVIRONMENT

The coastal plain of the Arctic NWR is located more than 250 miles north of the Arctic Circle in the remote northeast corner of Alaska adjacent to the Beaufort Sea. The coastal plain of the Arctic NWR extends south from the Beaufort Sea approximately 40 miles to the foothills of the Brooks Range. The coastal plain of the Arctic NWR extends from its western boundary, the Canning River, east approximately 100 miles to the Aichilik River. There are 10 large rivers and 14 named smaller rivers or streams in the coastal plain of the Arctic NWR. Rivers and streams flow north from the Brooks Range to the Beaufort Sea.

The Inupiat Eskimo village of Kaktovik is located on Barter Island just north of the coastal plain. Prudhoe Bay is located approximately 115 miles to the west of Kaktovik. There are no roads within the refuge. Access to the coastal plain of the Arctic NWR is by charter aircraft from either Prudhoe Bay, Barter Island or Fairbanks.

Wetlands

Approximately 99 percent of the coastal plain, Arctic NWR is classified as wetland. Wetlands in the Arctic are broken down in to five (5) classification systems: marine, estuarine, riverine, lacstrine, and palustrine. The systems are subdivided into a number of subsystems. The vast majority of the coastal plain of the Arctic NWR fall into the palustrine system, which is commonly referred to as wet tundra or tussock tundra (National Wetlands Inventory, unpublished). Arctic wetland areas generally have dense vegetative cover and permafrost occurring at a shallow depth due to the insulating effect of the vegetation. Soils in the wetland areas remain saturated throughout most of the growing season. The small area of non-wetland habitat along the coastal plain of the Arctic NWR is generally restricted to upland areas with sparse vegetation where depth to permafrost is great enough for soils to be well drained (Clough et al. 1987, and U.S. Fish and Wildlife 1988).

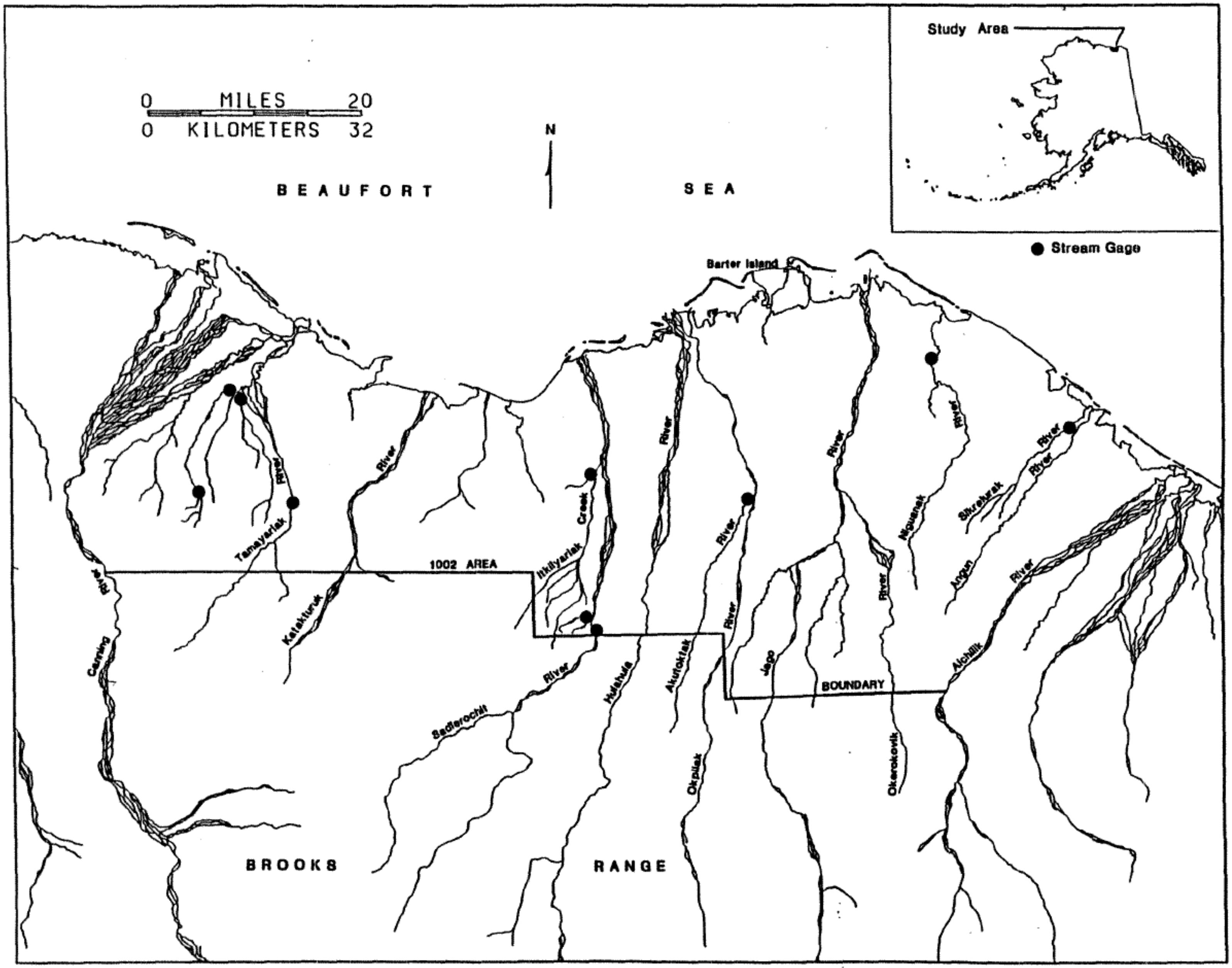

Figure 1.-The 1002 area of the Arctic National Wildlife Refuge with stream discharge gaging station locations.

Permafrost

Permafrost is a controlling physical force with respect to the water resources along the North Slope. Permafrost is defined as perennially frozen ground and may consist of soil, rock, minerals, organic matter, bedrock, and ice. With the exception of a small area associated with Sadlerochit Springs, the entire coastal plain of the Arctic NWR is thought to be underlain with permafrost with an active layer that is one to five feet thick. Permafrost depths across the Arctic slope range from a few feet to greater than 2,200 feet in the vicinity of Prudhoe Bay (Clough et al. 1987). Permafrost restricts infiltration of surface water, limits soil water storage and increases runoff from precipitation events. Permafrost also eliminates the availability of ground water within the frozen zone. The formation of ice wedges in the permafrost play an important role in the succession of thaw lakes (Sloan 1987).

Surficial Deposits

Surficial deposits in the Arctic NWR include Quarternary and Recent deposits of glacial, alluvial, eolian and colluvial sediments. Although at least six glacial advances occurred in the refuge, glaciers apparently never advanced more than a few miles beyond the present mountain front. Still, alluvium along the coastal plain of the Arctic NWR is reworked glacial deposits that have been eroded and transported by stream action (Clough et al. 1987, and Hartman 1973).

Climate

Climate of the coastal plain is considered to be Arctic marine (Clough et al. 1987), characterized by short, cool summers, with continuous daylight. Winters are long, dark, and extremely cold. The average temperature for the warmest month on Barter Island is 43°F. Daily summer temperatures vary from below freezing to the record high of 78°F. Winter temperatures are also extremely variable. The average January temperatures for Barter Island varied from +4.5°F in 1981 to -21.8°F in 1983. The record minimum temperature for Barter Island is -59°F set in February, 1950 (Clough et al. 1987). Temperatures along the coast are moderated by the effects of the open water of the Beaufort Sea. Summer winds, precipitation, and fog are generally greater in the immediate coastal areas while inland summer temperatures are warmer with a greater diurnal variation.

Precipitation along the coastal plain usually occurs as light rain or drizzle during the summer and as light snow in the winter. Snow may occur during any month of the year. Average precipitation for Barter Island is 6.3 inches (Clough et al. 1987). Snow accounts for more than half of the average annual precipitation. Most snow fall occurs from September-November and in January. Snow cover is persistent throughout the winter, though strong winds redistribute the snow creating large snow drifts and exposed ridges.

There are no precipitation gages located within the coastal plain of the Arctic NWR. The closest precipitation gage is located on Barter Island, and is operated by the U.S. Soil Conservation Service (SCS). The SCS also maintains six other precipitation gages in the Arctic region: Atigun Camp, Atigun Pass, Barrow, Prudhoe Bay, Sagwon, and Toolik River. The National Oceanic and Atmospheric Administration (NOAA) maintained a weather station on Barter Island from 1956 to 1989. NOAA presently maintains seven (7) weather stations in the Arctic region. The data collected from these weather stations are not representative of precipitation events that occur in the drainage basins of the Arctic NWR coastal plain area, but do provide general climatic conditions for the Arctic slope.

Vegetation Types

Walker et al. (1982) mapped five (5) distinct vegetation cover types on the coastal plain, Arctic NWR: foothills (45%), river flood plains (25%), hilly coastal plains (22%), flat thaw-lake plains (3%), and mountains (0.05%). Foothill vegetation cover type comprises about 45% of the Arctic NWR coastal plain, and extends from the Canning River to the Sadlerochit River, and rises from Camden Bay to the foothills of the Sadlerochit Mountains. Vegetation is dominated by sedges and tussock forming sedges. Dwarf willow and birch is common, but sparsely distributed. The river flood plain vegetation type consists of the barren deltas and river flood plains of the larger rivers, terraces and alluvial areas associated with old river channels, and the deltaic formations at the base of the foothills. Land cover of the river flood plain vegetation includes water, barren and sparsely vegetated flood plains, wet germinoid, moist/wet tundra complex, dry prostrate dwarf scrub and moist graminoid tussock tundra. The hilly coastal plain cover type accounts for 22% of the coastal plain of the Arctic NWR, mainly east of the Sadlerochit River. This region with slightly elevated ridges and depressions is dominated by moist/wet tussock tundra and moist prostrate dwarf scrub. Flat thaw-lake plains compromise 3% of the coastal plain of the Arctic NWR located generally between the Canning and Tamayariak River Deltas. The mountain terrain area is complex and is interspersed with nonvegetated and talused slopes mostly above 1,970 feet. The vegetation types mapped by Walker et al. (1982) are different from those used in the National Wetland Inventory.

Wildlife Resources

Approximately 30 species of mammals use the coastal plain, Arctic NWR and its coastal waters, eight of which are marine mammals (Tweeten 1985, and Clough et al. 1987). The entire coastal plain of the Arctic NWR is within the calving grounds of the Porcupine caribou herd numbering 180,000 animals in 1986. Sixty-four muskox were reintroduced in to the coastal plain of the Arctic NWR in 1969 and 1970. In 1985 the population was estimated at more than 476 animals. Moose, Dall sheep, wolves, Arctic foxes, brown bears, and a variety of ground squirrels and rodents are found throughout the coastal plain of the Arctic NWR. Polar bears, seals, and whales are found in or near the refuge coastal waters. The endangered bowhead whale is found off the coast of

the coastal plain and is taken for subsistence by the residents of Kaktovik (Clough et al. 1987).

One hundred thirty-five species of birds have been recorded on the coastal plain, Arctic NWR (Clough et al. 1987). The majority are migratory, and are present for only a brief period between May and September. Six species are considered to be year round residence: rock and willow ptarmigan, snowy owl, common raven, gyrfalcon, and the American dipper. Swans, geese and ducks use the coastal plain area for breeding and/or staging. As many as 100 swan nests have been observed during annual surveys. Four species of geese use the coastal plain annually. Seven species of seabirds are known to breed there. Tundra habitats within the river delta areas and riparian habitats are important nesting and staging areas for shorebirds. Several species of raptures including the endangered American peregrine falcon and the threatened Arctic peregrine falcon are found in the Arctic NWR. Riparian willow stands support the highest nesting density and diversity of passerine species along the coastal plain of the Arctic NWR (Clough et al. 1987).

Fishery Resources

West and Fruge (1989) reviewed the fishery surveys conducted on the lakes and streams of the coastal plain of the Arctic NWR. Twenty-five fish species have been reported in the coastal and inland waters (Table 1). Seven species were reported in stream of the coastal plain of the Arctic NWR. Six freshwater/marine and one marine species have been collected from lakes (West and Fruge 1989). Winter habitat limits the abundance and distribution of Arctic fishes. Springs, deep lakes and isolated deep pools in the rivers provide limited overwintering habitat. The Canning River, Tamayariak River, Sadlerochit Spring Creek, Sadlerochit River, and the Hulahula River are considered important over wintering areas within the coastal plain of the Arctic NWR. There are a limited number of lakes with depth great enough to provide wintering fish habitat. Arctic char, Arctic grayling, and ninespine sticklebacks are the most common occurring fish in the freshwater systems. The lagoons, bays and estuaries of the coastal plain are an important habitat for the fishery resources. Input from the stream to coastal areas create a water temperature and salinity gradient in the lagoons, bays and estuaries. The large flush of water that occurs during breakup creates these gradients (T.J. Underwood, U.S. Fish and Wildlife Service, personal communication). The functional intricacies of the coastal habitat is not completely understood.

HYDROLOGY

The Arctic climate and permafrost are the controlling physical forces of the hydrologic cycle across the coastal plain. The extreme cold temperatures and short days during the winter cause the streams and lakes to freeze to substrate. There is a six month period during which most stream flow ceases. The only non-frozen water during the winter months is located in small isolated pools beneath ice hummocks, lakes with depth greater than seven feet, and flowing surface waters associated with springs. Breakup on the North Slope occurs in a brief period in late-May or early-June. Snowmelt begins

Table 1.—List of fish species reported from coastal plain of the Arctic National Wildlife Refuge (West and Fruge 1989).

Anadromous	Freshwater	Marine
Arctic char	Arctic grayling	Arctic cod
Arctic cisco	Burbot	Arctic sculpin
Broad whitefish	Lake trout	Arctic flounder
Chum salmon	Round whitefish	Bering wolfish
Least cisco		Capelin
Ninespine stickleback		Fourhorn sculpin
Pink salmon		Kelp snailfish
Rainbow smelt		Pacific hearing
		Pacific sand lance
		Pallid ellpout
		Saffron cod
		Stout eelblenny
		Slender eelblenny

earliest in the mountains and foothills and progresses towards the coastal plain. The rapidly melting water from the foothills runs over the frozen ground as sheetflow. Infiltration is prohibited because of the presence of permafrost. Water in the stream channels rises rapidly, flowing over ice covered stream channels. As much as 50 percent of the annual flow of North Slope rivers may take place during breakup (Clough et al. 1987, and Sloan 1987).

Streams

Hydrologic data for the coastal plain are limited. Childers et al. (1977) reported a reconnaissance level investigation of rivers, springs, aufeis fields, and lakes of the Arctic coastal plain including the coastal plain area of the Arctic NWR. Childers et al. (1977) reported data on channel characteristics, watershed characteristics, and estimated flood characteristics of the Canning River, Marsh Creek, Sadlerochit River, Hulahula River, Jago River, and Okerokovik River. Daum et al. (1984), Glesne and Deschermeier (1984), and Smith and Glesne (1982) reported selected physical and chemical characteristics of streams and springs across the coastal plain of the Arctic NWR. Elliott and Lyons (1990) reported on the availability of winter water within stream systems within the coastal plain of the Arctic NWR.

The U.S. Geological Survey (USGS) currently operates five (5) stream gaging stations along the Arctic slope of Alaska and has limited historical data on several other streams (Table 2). The closest USGS stream gaging station to the coastal plain of the Arctic NWR is located on the Sagavanirktok River (USGS gage #15908000) near pump station 3. The Sagavanirktok River is located 80 miles west of the Canning River, the western boundary of the coastal plain of the Arctic NWR. The Sagavanirktok River is larger then any river in the coastal plain area of the Arctic NWR.

Table 2.—Index to USGS gaging stations located along the Arctic Slope, Alaska (Still and Cosby 1989).

Station Identification	Name	Location Latitude	Location Longitude	Drainage Area mi.²	Years of Record
15798700	Nunavak Creek near Barrow	71°15'35"	156°46'57"	a2.79	b1971-92
15799000	Esatkuat Creek near Barrow	71°16'30"	156°43'44"	1.46	1972-73
15799300	Esatkuat Lagoon	71°17'40"	156°46'06"	3.52	1972-73
15803000	Meade River at Atkasuk	70°29'20"	157°24'40"	a1800	1977
15830000	Miguakiak River near Teshekpuk Lake near Lonely	70°40'13"	154°19'20"	a1460	1977
15880000	Colville River near Nuiqusit	70°09'56"	150°55'00"	20670	1977
15896000	Kuparuk River near Deadhorse	70°16'54"	148°57'35"	3130	b1971-92
15896700	Putuligayuk River near Deadhorse	70°16'30"	148°37'41"	a176	1970-79 1981-86
15904900	Atigun River tributary near Pump Station 4	68°22'25"	149°18'48"	32.6	1976-86
15906000	Sagavanirktok River tributary near Pump Station 3	68°41'13"	149°05'42"	28.4	b1987-92
15908000	Sagavanirktok River near Pump Station 3	69°00'54"	148°49'02"	a1860	b1982-92
15910000	Sagavanirktok River near Sagwon	69°05'24"	148°45'34"	229	1970-78
15975000	Chamberlin Creek near Peters Lake	69°17'30"	144°57'50"	1.46	1958
15976000	Neruokpukkoonga Creek near Peters Lake	69°18'30"	145°01'30"	123	1958
15904800	Atigun River near Pump Station 4	68°12'54"	149°24'13"	48.7	b1992

a Approximate Area
b Record may extend beyond 1992

Springs

Childers et al. (1977) conducted a reconnaissance investigation of the springs on the eastern North Slope, Alaska. The study included 18 springs, 6 of which are located within the coastal plain, Arctic NWR: Sadlerochit Spring, Red Hill Spring, Katakturuk River tributary spring, Hulahula River spring at fish hole #1, Okerokovik River spring, and Aichilik River spring. Sadlerochit Spring is the largest within the coastal plain of the Arctic NWR. During the winter months pressurized water discharged from a spring pushes up through the ice to the surface, spreads out and freezes forming aufeis or icings. Aufeis formations may become extensive. Aufeis formations melt slower than snow and often persists throughout the summer. Open water associated with springs become important wintering habitat once surface runoff has ceased due to freezing.

Lakes

Lakes located on the coastal plain of the Arctic NWR tend to be shallow thaw lakes with surface areas ranging from 1,500 acres to less than 10 acres. Distribution of lakes is uneven. The majority of the lakes are located at the mouth of the Canning River or in the vicinity of the Jago River. Thaw lakes form in relatively flat terrain and in general are isolated from river drainage systems by permafrost. Recharge is limited to snowmelt and direct precipitation within the lakes' small recharge area. The topographic relief on the western portion (between the Canning river and the Sadlerochit River) of the Arctic NWR prohibits the formation of thaw lakes.

Ice thickness is snow cover or water depth dependent, but in general ice thickness is 2 feet by mid-November and by mid-January the ice thickness is 4 feet. The maximum ice thickness on lakes along the coastal plain is 6 to 7 feet (Bilello and Bates 1969, 1971, 1972, and 1975). Shallow lakes that freeze to the bottom in the winter melt from the surface down. Ice on the deeper lakes that do not freeze to substrate may be present well into July.

Childers et al. (1977) sampled six lakes for water quality, ice thickness, and water depth. A study of the quantity and distribution of water within lakes of the coastal plain of the Arctic NWR was conducted and reported by Elliott (1990), and Trawicki et al. (1991).

Groundwater

Little information is known about the groundwater in the coastal plain, Arctic NWR. Groundwater that may exist below permafrost (subpermafrost) is thought to be saline or brackish (Williams 1970). Several test wells have been drilled in the vicinity of Prudhoe Bay and the Kuparuk River with little success of finding water. Water that has been found in the oil and gas fields of the North Slope is a sodium-chloride type, high in dissolved solids with salinity ranging from brackish to brine (Sloan 1987). Groundwater located above permafrost (suprapermafrost) occurs beneath rivers and lakes. Suprapermafrost plays a major role in the formation of surface features suchas

wetlands, patterned ground, pingos, and shallow lakes (Nelson and Munter 1990). Suprapermafrost water may be available on a seasonal basis but is susceptible to contamination (Nelson and Munter 1990). No information is currently available concerning suprapermafrost water in the coastal plain, Arctic NWR.

Watershed Description

Akutoktak River: Also referred to as the Akootoaktuk River on some USGS maps, headwaters in the foothills of the Romanzof Mountains and is the largest west side tributary to the Okpilak River. The U.S. Fish and Wildlife Service gaging station was located 0.6 miles upstream from the confluence with the Okpilak River. The gaged drainage area was 97 mi^2 of which 66 mi^2 is located within the Arctic NWR Wilderness Area. The Akutoktak River is a clear water, low gradient, braided, stream with intermittent summer flow in the upper portion. The Akutoktak River freezes to substrate in the fall and there is no winter flow. Stream width at the gaging station was approximately 65 feet. Substrate and islands are composed of gravel and cobble. Arctic char, Arctic grayling and ninespine stickleback are present in the Akutoktak River (Wiswar 1991).

Itkilyariak Creek, West Fork: The West Fork Itkilyariak Creek is a tributary to Itkilyariak Creek, which in turn is the largest west side tributary to the Sadlerochit River. The Sadlerochit Mountains are the headwaters of the Itkilyariak Creek drainage. The U.S Fish and Wildlife Service gaging station is located on the west fork tributary 0.6 miles upstream from the confluence of the Itkilyariak Creek. The drainage area above the gaging station is 27 mi^2 of which one third of the area is located in the Arctic NWR Wilderness Area. Substrate and islands are unstable gravel and cobble. The channel is braided and summer flow is intermittent at times. Flow ceases during the winter months. Adult and juvenile Arctic grayling have been observed in the West Fork. Arctic char and ninespine stickleback are present in the Itkilyariak River drainage.

Niguanak River: The Niguanak River is a small tundra drainage east of the Jago River that empties into the Oruktalik Lagoon. The flow in the Niguanak River is derived from melting snow and stormflow events. The channel is low gradient, substrate is sand and gravel, summer flow is often intermittent and there is no flow during the winer months. Drainage area above the U.S. Fish and Wildlife Service gage is 136 mi^2. The topographic relief in this area is generally flat. Ninespine sticklebacks are the only fish to have been observed in the Niguanak River drainage.

Sadlerochit River: The headwaters of the Sadlerochit River are located high in the Brooks Range and are fairly extensive. Peters and Schrader Lakes, two adjoining glacial lakes, are significant contributors to the Sadlerochit River system. The drainage area above the U.S. Fish and Wildlife Service gaging station is 520 mi^2. The gaging station was located were the river comes out of the mountains. The gradient is moderate to high at and above the gaging station, but quickly turns low as the river reaches the coastal plain. Substrate is cobble and boulder in the mountains and turns to sand, gravel, and cobble along the coastal plain. Aufeis formations are present on the

Sadlerochit River along the coastal plain. Water is generally clear, but may become turbid during breakup and storm events. Flow is present during the summer months in the Sadlerochit River, but the river does freeze to substrate during the winter months. Arctic char, Arctic grayling, and ninespine stickleback are present in the Sadlerochit River (West and Fruge 1989).

Sadlerochit Spring Creek: There are two primary spring sources to Sadlerochit Spring Creek. Both sources emerge from the base of the eastern end of the Sadlerochit Mountains and converge to form a single channel. Drainage area above the U.S. Fish and Wildlife Service stream gaging station is 0.5 m^2. (Note: On USGS topographic maps Sadlerochit Spring Creek is shown to be a primary tributary to the Sadlerochit River.) In actuality Sadlerochit Spring flows north parallel to the Sadlerochit River and is a tributary to the Itkilyariak Creek which in turn is a tributary to the Sadlerochit River. Sadlerochit Spring Creek becomes braided about three miles below its origin. The braided channel marks the upper extent of the aufeis formation that develops over the winter. In July of 1987, the aufeis was over two miles long and a mile wide, with ice thicknesses greater than 5 ft. Downstream of the aufeis field the creek channel remains braided for the three miles to its confluence with the Itkilyariak Creek. A resident population of Arctic char and grayling are present in the creek.

Sikrelurak River: The Sikrelurak River is a small tundra drainage east of the Jago River. The flow in the Sikrelurak River is derived from melting snow and stormflow events. The channel is low gradient. Substrate is sand and gravel. Summer flow is often intermittent and there is no flow during the winter. Drainage area above the U.S. Fish and Wildlife Service gage is 75 mi^2. Ninespine stickleback and one Arctic char have been observed in this drainage.

Tamayariak River: Because of the complexity of the drainage system and the multiple resource values in this area four U.S. Fish and Wildlife Service stream gaging stations were installed in the Tamayariak River drainage: Tamayariak River, Middle Fork Tamayariak River, Lower West Fork Tamayariak River and the Upper West Fork Tamayariak River. The Tamayariak River is a tributary to the Canning River with its origin in the Sadlerochit Mountains. Total drainage area is approximately 350 mi^2. The foothills extend out towards the coast in this area giving the Tamayariak River drainage some topographic relief. The area is described as hilly. The drainage crosses the Marsh Creek Fault where the channel often becomes dry. Flow resumes 2 to 3 miles down stream in the vicinity of the springs and aufeis formation. The channel drying up is also evident on the West Fork of the Tamayariak River. Just at or below the Upper West Fork gaging station surface flow ceased on an annual basis. Several miles downstream a series of springs rejuvenate the stream flow and surface flows were recorded at the Lower West Fork gaging station. The Tamayariak River and its tributaries become more braided as the river size increases moving downstream. There is an aufeis formation on the mainstem four miles upstream from the confluence with the West Fork. From the icing to the confluence with the West Fork the mainstem is extensively braided. From the confluence with the West Fork moving downstream the river becomes less braided, eventually forming a single channel before joining the Canning River near tidewater. Arctic grayling have been observed extensively

throughout the drainage. Arctic char and ninespine stickleback are also present in the Tamayariak River drainage. Muskox were observed on a regular basis in the Tamayariak River drainage.

METHODS

Project Scoping

A multilevel scoping process was conducted to define the issues and concerns of oil and gas exploration on the water resources in the coastal plain, Arctic NWR. Initially a watershed priority matrix was developed to assist land managers in identifying drainage basins and lakes in need of immediate attention. The matrix included eight probable development impacts and 32 resource values. Resource values, impact severity, and likelihood of occurrence were rated from 1 to 10. Values for each stream were summed and compared (Tweeten 1985). In 1986 a second priority matrix was developed to re-evaluate and determine the need for resource inventories on streams in the coastal plain, Arctic NWR. The second matrix included 25 resource value categories, 15 development pressures and 7 management conflict categories (Lyons and Elliot 1987, unpublished plan of study). As part of the matrix evaluation a scoping meeting was conducted with the Arctic NWR staff and the Fairbanks Fishery Resources Office and Wildlife Enhancement Field Station personnel. Areas of biological importance and threatened critical habitats were identified.

Stream Discharge

Water depth and temperature measurements were taken at stream gaging stations. A pressure transducer and temperature thermistor were attached to an anchor and placed on the stream bottom. A cable connected the transducer and the thermistor to a computerized field recorder located along the stream bank. The field recorder and battery were placed in the weather shelter and the cable was buried to minimize damage from wildlife and floating debris. A reference elevation bench mark was established at each site.

Pressure transducers were calibrated prior to field use. The computerized field recorder measured water depth and temperature readings at 5 minute intervals. Water depths were measured to the nearest 0.01 feet, and water temperature to the nearest 0.1°C. At the end of each 24 hour period the field recorder summarized the 5 minute readings into a report that contained: average daily depth, maximum depth and time of maximum depth, minimum depth and time of minimum depth, average water temperature, maximum water temperature and time of maximum temperature, and minimum temperature and time of minimum temperature. The summarized data was stored on a data storage pack. The summarized data were later downloaded onto a computer.

Stream gaging stations were installed annually in early June, following breakup and removed from operation at freeze-up, during late September. Calibration data were collected using standard stream discharge measurement procedures (Buchanan and Somers 1969, and Lyons 1988) and included stream

discharge in cubic feet per second (cfs), water depth, and water surface elevation with respect to the reference bench mark. Calibration data were collected throughout all months of stream gage operation. Calibration data were collected during high and low flow periods to increase the range of the calibration.

A rating curve for each gaging station was developed through regression analysis of water depth (the independent variable) and stream discharge (the dependant variable). The resultant regression equation was then used to convert the recorded water depth to stream discharge. Since stream gages were not permanent, a new relationship between water depth and stream discharge was required for each year of operation.

Average daily discharges were estimated for gaging stations that experienced technical problems during the stream gaging period. Technical problems included equipment malfunction, damage to gaging equipment from wildlife or flooding. For a single missing data point not associated with a storm event, the missing data point was estimated by averaging the average daily discharge from the day prior to and the day following the missing data point. For small data gaps (2-5 days), not associated with a hydrologic event, data points were estimated by analyzing the trend of the average daily discharge of one or more similar drainage for the period of missing data. Data points were then estimated to fit the trend of the similar drainage. For larger data gaps, a linear relationship was established between the stream with missing data and a stream with similar watershed characteristics and discharge rates. The relationship was established from the average daily discharge for all days that the two streams had records in common. The linear relationship was used to estimate the missing average daily discharge of one stream from the known average daily discharge of the other stream. Where no relationship could be established between two rivers the data gap was left as missing data. Estimates of missing peak discharge events were calculated using the indirect slope-area method as outlined in the Geological Survey Water-Supply Paper 2175 (Rantz 1982). Because breakup is a regional climatic event driven by increasing air temperatures, estimates of discharge during breakup were made using a linear regression analysis between rivers of the Arctic NWR and the Kuparuk River. The stream gaging station on the Kuparuk River is located on the coastal plain 10 miles upstream from Gwyder Bay and 13 miles northwest of Deadhorse. The Kuparuk River gaging station has more than 20 years of record.

Flood flow frequency estimates were determined using the log-Pearson Type III distribution (Hydrology Subcommittee 1982). Flood flow frequencies were plotted using the Hydrologic Engineering Center's HECWRC Flood Flow Frequency Analysis Computer Program 723-X6-L7550 (US Army Corps of Engineers 1982). The annual maximum recorded or estimated discharge from a rainfall event was used for each station for each year of record. Annual maximum discharge from snowmelt during breakup was not included in this analysis and will be addressed separately. Using the equation:

$$\text{Log } Q = \bar{X} + KS$$

where:
- Q = discharge
- $\bar{X}$ = mean logarithm
- K = a function of the skew and exceedence probability
- S = standard deviation of logarithms

Discharge events were fitted to the log-Pearson Type III distribution at the 2, 5, 10 and 25 year exceedence probabilities using a generalized skew coefficient of logarithms of 0.70 (Hydrologic Subcommittee 1982).

The annual seven (7) day low flow is the lowest average of the mean daily discharge for seven consecutive days. The annual seven (7) day low flow was calculated for each stream for each year of record. All annual seven (7) day low flow calculations are based on the open water season (June through September). The average seven (7) day low flow for the period of record was also calculated for each stream by averaging the annual seven (7) day low flow for all years of record.

Winter Water in Streams

Data gaps identified by Elliott (1989) provided the basis for the investigation to determine the volume of water in pools located beneath ice hummocks (pressure ridges) and the distribution of the ice hummocks within the major river drainage along the coastal plain of the Arctic NWR (Elliott and Lyons 1990).

River drainages were flown by helicopter in April of 1989, when river ice thickness was at its maximum. Ice hummock locations were plotted on 1:63,360 scale topographic maps. The height and length of each hummock was estimated. Periodic ground truthing of ice hummock length and height was conducted.

A sample of nine ice hummocks was measured to determine length, height and water depth. A series of holes were drilled along the long axis of each hummock to determine the water margins located beneath the ice. Three additional transacts were drilled perpendicular to the original. Water depth was measured in each hole. Contour maps were created for each pool measured. Pool size and volume were than calculated from the contour maps (Elliot and Lyons 1990).

A linear relationship was than established between the size coefficient (product of length and maximum height of the hummock) and the volume of water beneath the ice hummock. Water volumes were than estimated for ice hummocks plotted on the topographic maps. Total water volume for each drainage was than calculated by summing the pool volume estimates of each hummock in the drainage.

Lake Volume

The quantity and distribution of water within lakes in the coastal plain area of the Arctic NWR were evaluated to identify water availability throughout the year (Trawicki et al. 1991). Lakes were identified for evaluation from U.S. Geological Survey topographic (1:63,360) maps. Identification of lakes was based on surface area.

Water depth, to the nearest 0.1 feet, was measured along a minimum of 6 transacts per lake. Depth measurements were taken with a recording fathometer

mounted on the back of an inflatable boat. The fathometers were calibrated at each lake before transacts were run. Lakes with maximum depths less than 2.5 feet were not measured using the fathometer. Surface area and estimates of maximum depth were used to approximate the volume of these shallow lakes.

Enlargement of U.S. Geological Survey maps provided lake shoreline maps. Water depth transect data were plotted on the shoreline maps. Contour lines for 1 foot intervals were then drawn on each shoreline map. The area of each 1 foot contour was measured using a planimeter. Lake volume was than calculated for the entire lake. Water volumes during the winter months were calculated by subtracting 1 foot strata volumes from the ice-free volume to estimate the volume of water beneath successive 1 foot intervals of ice. Ice thickness dates were based on Bilello and Bates (1969, 1971, 1972 and 1975) 8 years of ice thickness data for Barter Island.

Lake Surface Water Elevations

The second part of the study of lakes on the coastal plain of the Arctic NWR was to survey the elevation of the lake water level and the outer perimeter of the wet meadow zone (the annual high water level). The water surface elevation was that of the day the survey was conducted. In August 1993, Global Positioning Services, Inc. was contracted to accomplish the survey. The survey was conducted using state of the art global positioning system (GPS) technology.

A single local datum was established and tied to 27 monuments and three oil wells. The oil wells were located outside the Refuge boundaries. Fast static GPS receivers with digital data link were used. At each lake or complex of lakes a primary hub was set. A real time kinematics observation was taken. The receiver was than repositioned and a redundancy observation was recorded. Subsequent observations were taken at the waters' edge (present water surface elevation) and at the upper edge of the wet meadow zone (the annual high water level). The ellipsoidal elevations were determined during post-processing. Ellipsoidal height, latitude, and longitude of all monuments were confirmed during post processing as a check on the accuracy of the process (Global Positioning Services 1993). Video footage and/or photographs were taken of each lake identifying the perimeter of the wet meadow zone. A detailed description of the methods and results, and maps containing the surveyed lakes are printed in Global Positioning Services, Inc. (1993).

RESULTS

Project Scoping

The priority matrices identified six streams as high priority. These streams included the Hulahula River, Canning River, Okpilak River, Sadlerochit River, Jago River (Okerokovik Spring) and the Kogopak River. During the scoping meetings with the Arctic NWR staff it was determined that the Tamayariak River and Sadlerochit Spring Creek should also be included as high priority streams. The Tamayariak River has an abundance of fish and wildlife

resource values that were overlooked during the initial evaluation and Sadlerochit Springs is an area unique with fish, wildlife, and cultural values.

In July and September of 1987 a reconnaissance trip was conducted across the coastal plain of the Arctic NWR to determine feasibility and location of potential stream gaging stations. Results of the reconnaissance trip during the early summer of 1987 concluded that stream gages could not be operated on a year round basis and that stream gaging station locations were limited due to extreme braided channels and intermittent flow. It was recommended that stream gaging stations be installed on Tamayariak River, Sadlerochit River, Sadlerochit Spring Creek, Itkilyariak Creek and the Akutoktak River (Figure 1). Since the Tamayariak River is a hydrological diverse system with abundant fish and wildlife resources, four stream gaging stations were installed on this watershed. The Water Resources Branch initiated a stream gaging network consisting of eight (8) gaging stations in the coastal plain area of the Arctic NWR in 1988. In 1989 two additional stream gaging stations were installed on two tundra streams on the eastern portion of the refuge. The new gaging stations were located on the Niguanak River and Sikrelurak River. Table 3, contains the legal description of the location of each stream gaging station.

Table 3.—Stream gaging station locations (Umiat Meridian).

Watershed	Gage Location
Akutoktak River	Center sec.36, T6N, R33E
West Fork, Itkilyariak Creek	NE¼NW¼NW¼ sec.33, T6N, R31E
Niguanak River	NW¼NW¼NE¼ sec.36, T8N, R36E
Sadlerochit River	NW¼SW¼ sec.31, T4N, R32E
Sadlerochit Spring Creek	NE¼NW¼ sec.36, T4N, R31E
Sikrelurak River	SE¼SE¼ sec.36, T7N, R38E
Tamayariak River	SW¼NE¼ sec.35, T6N, R26E
Lower West Fork, Tamayariak River	NW¼NW¼ sec.12, T7N, R25E
Middle Fork, Tamayariak River	Center sec.12, T7N, R25E
Upper West Fork, Tamayariak River	W½W½ sec.33, T6N, R25E

The Canning and Hulahula Rivers rated high in the priority matrix and were not gaged due to equipment and logistical constraints. Both of these rivers have significant fishery resources. The Hulahula and Canning Rivers are also highly used recreational rivers. As technology advances, the equipment and logistical constraints will be overcome. The Okpilak and Jago-Okerokovik Springs were not gaged due to lack of suitable gaging station locations.

The Kogopak River is a tundra stream located on the eastern end of the coastal plain of the Arctic NWR. The Kogopak River was not gaged, but gages were installed on the Niguanak and Sikrelurak Rivers, two tundra streams with similar drainage characteristics.

Stream Discharge

These data represent the hydrologic conditions for the 1988-1992 summer stream gaging seasons. Stream gaging stations were installed between July 18 and July 20, 1988, on the Akutoktak River, Itkilyariak Creek, Sadlerochit River, Sadlerochit Spring Creek, Tamayariak River, Middle Fork Tamayariak River, Lower West Fork Tamayariak River, and the Upper West Fork Tamayariak River. All stream gaging stations were in service until Sept. 27 or 28, 1988. In 1989 stream gaging stations were reinstalled at the 1988 stream gaging sites with the exception of the gage located on the Itkilyariak Creek. The Itkilyariak Creek stream gage was moved to the West Fork Itkilyariak Creek. The two additional gaging stations located on the Niguanak and Sikrelurak Rivers were also installed. Gaging stations were installed between June 14 and June 29, 1989, and remained in operation until September 24, 1989. Similarly, all 10 gaging stations were reinstalled during the open water months in 1990, 1991, and 1992. Stream gages were installed each spring just after breakup when river bottoms were free of anchor ice. Gages were in operation until mid to late September each year.

Rating curves were developed for each stream gage for each year of operation. Polynomial relationships between stage and discharge were developed for all stations except Sadlerochit Springs, were a linear relationship was used. The correlation coefficient for all relationships ranged from 0.95 to 0.99. The average daily discharge for each station for each year of record is reported in Appendix A. Summary statistics are reported in Table 4.

During the five (5) years of data collection bears, ground squirrels, floods, equipment malfunction, and human error resulted in several data gaps. Data gaps were estimated when possible. All estimated data reported in Appendix A and are denoted with an "e". Estimates of small data gaps are considered to be fair. Estimates of larger data gaps are poor. When no reasonable method or estimate could be made the data gap was left as missing data. On July 21, 1991, a large flood event washed out the gaging stations on the Sadlerochit and Tamayariak Rivers. A field camp located along the bank of the Sadlerochit River had to moved because of overbank flooding. Another geology field camp was completely washed away. Estimates of peak flows from this event were estimated using the slope-area method (Darymple et al. 1967). Estimates of discharge during breakup were made using a linear relationship between the USGS data from the Kuparuk River and the rivers located on the coastal plain of the Arctic NWR. Estimates of the breakup flows are considered to be poor, but are the best professional estimates available.

Flood frequency estimates are based on high discharge from precipitation events. Flooding that occurred during breakup was excluded from the analysis.

Table 4.–Summary statistics for the open water season of gaged streams within the coastal plain area, Arctic National Wildlife Refuge, Alaska.

Watershed	Drainage Area (mi^2)	Average Annual Discharge (cfs)	Average Total Runoff (in)	Peak Flow (cfsm)	Date of Peak Flow	Average 7-Day Low Flow (cfs)	Years of Record
Akutoktak River	97.1	102	4.42	18.7	08/27/92	4.0	1988-92
Itkilyariak Cr., West Fork	26.9	70	8.67	52.8	08/20/89	1.8	1989-92
Niguanak River	136.2	233	8.85	68.0	08/21/89	14.5	1989-91
Sadlerochit River	520.1	1144	8.07	40.4	07/21/91	190.3	1988-92
Sadlerochit Spring Cr.	0.5	37	1012.90	216.0	08/20/89	28.0	1988-90 1992
Sikrelurak River	74.7	93	5.43	23.9	06/04/91	2.2	1989-92
Tamayariak River	136.1	305	9.90	38.2	07/21/91	45.6	1988-92
Tamayariak River, Lower West Fork	98.1	179	8.3	25.0	09/06/90	14.9	1988-91
Tamayariak River, Middle Fork	61.3	123	9.1	30.5	06/04/91	5.6	1988-92
Tamayariak River, Upper West Fork	49.2	128	11.3	30.0	08/20/89	2.9	1988-92

Results of the flood flow frequency analysis are given in Table 5. Flood flow estimates were calculated for the 2, 5, 10, and 25 year flood frequency events. From the table it can be inferred that the two year storm on the Akutoktak River is equal to 485 cfs or there is a 50% chance that a flow of 485 cfs will be exceeded in any given year. Flood flow estimates calculated for the Akutoktak River, Sadlerochit River, Tamayariak River, and Middle Fork Tamayariak River are based on five (5) years of data. Estimates for West Fork Itkilyariak Creek and Upper West Fork Tamayariak River are each based on four years of record. No flood flow estimates were calculated on the Niguanak River, Sikrelurak River, Lower West Fork Tamayariak River and Sadlerochit Spring Creek. The Hydrologic Subcommittee (1982) requires a minimum of 10 years of data for statistically reliable flood flow frequency analysis. The flood flow frequency estimates in Table 5 are based on less than 10 years of data and should be used with caution. The relatively high standard deviation is an indication of the low confidence of the flood flow estimates.

The annual seven (7) day low flow was calculated for each stream for each year of record and is reported in the summary statistics at the bottom of each Table in Appendix A. All low flow calculations are based on the open water season (June through September). The average seven (7) day low flow for the period of record for each stream is reported in Table 4. The annual seven (7) day low flow was less than 1 cfs on the Akutoktak River, West Fork Itkilyariak Creek, Niguanak River, Sikrelurak River, and the Middle and Upper West Fork Tamayariak River. During the winter months all streams freeze to substrate and flow goes to zero (Elliott and Lyons 1990). The exceptions to this are short segments of streams associated with springs. Sadlerochit Spring Creek is open year round from its source for approximately 3 miles to where the channel becomes braided and the aufeis forms in the winter.

Table 5.—Estimates of the 2, 5, 10 and 25 year flood events. Q_t is discharge in cubic feet per second. (Note: These estimates are based on less than 10 years of data and should be used with caution).

Watershed	Q_2 (cfs)	Q_5 (cfs)	Q_{10} (cfs)	Q_{25} (cfs)	Years	Mean Logarithm	Standard Deviation
Akutoktak River	485	1470	2850	6180	5	2.7470	0.5310
Sadlerochit River	5960	12700	20000	34000	5	3.8173	0.3633
Itkilyariak Creek, WF	553	1250	2030	3590	4	2.7881	0.3901
Tamayariak River	2420	4360	6200	9350	5	3.4167	0.2819
Tamayariak River, MF	695	1250	1780	2680	5	2.8747	0.2815
Tamayariak River, UWF	925	1600	2220	3250	4	2.9963	0.2622

Winter Water in Streams

Six hundred and four (604) ice hummocks were identified along approximately 237 miles of river in seven major drainage of the coastal plain area of the Arctic NWR in 1989. Nine ice hummocks were sampled for length, width, height and water depth. Table 6 contains the size parameters and water volumes of the nine measured ice hummocks. A positive linear correlation between size coefficient (C) and pool volume (V) of

$$V = 38.16C - 8679.66$$
$$(r^2 = 0.77)$$

was used to estimate the pool volume for each ice hummock inventoried. The size coefficient is the product of length and height. Water was found beneath seven of the nine ice hummocks sampled. Two of the ice hummocks were frozen to substrate. A total of 8,839,200 gallons (27.1 acre-ft) of water was estimated to occur beneath the 604 ice hummocks. Table 7 contains a summary of the water by drainage located beneath ice hummocks of the coastal plain, Arctic NWR (Elliott and Lyons 1990).

Lake Volume

Over a three year period 119 lakes were surveyed to estimate water availability throughout the year. Surface areas of lakes surveyed ranged from 0 to 1,533 acres. Maximum depths for individual lakes ranged from 0 to 24.8 ft. with an average maximum depth of 6.7 feet. Fifty-nine of the surveyed lakes had maximum depths that exceeded 7.0 feet. Four of the 119 lakes identified on the U.S. Geological Survey topographic maps were dry or contained less than one ft. of water. Individual lake volumes during ice free conditions ranged from 0 to 9,285 acre-ft. Total volume for the 119 lakes was 55,379 acre-ft. When ice thickness reaches 4 ft. (early January) 34 lakes will have frozen to substrate and the remaining total volume of water will be 17,755 acre-ft from 85 lakes. By mid-April when ice is at its maximum thickness 60 lakes will have frozen solid. Total remaining volume would be approximately 3,365 acre-ft. from 59 lakes. Location, surface area, maximum depth, and volume with increasing ice thicknesses for individual lakes is reported in Trawicki et al. (1991).

Unlike the majority of the North Slope where low topographic relief permits the formation of numerous thaw lakes, the rolling hill topography east of the Canning River prohibits the formation of thaw lakes. The majority of the lakes along the coastal plain of the Arctic NWR are located at the mouth of the Canning River and in the vicinity of the Jago River. There is large region between the Tamayariak and Okpilak Rivers, an area roughly 40 miles wide, that is nearly void of lakes.

Lake Surface Water Elevations

State-of-the-art GPS equipment and techniques were used to survey the water surface elevation and outer perimeter of the wet meadow zone for 150 lakes on

Table 6.—Size parameters and calculated water volumes of the nine ice hummocks selected for study (Elliott and Lyons 1990).

Drainage	Hummock Number	Maximum Height (ft)	Length (ft)	Size Coefficient	Water Volume (gal)
Tamayariak River	1	6.5	90	585	22,180
Katakturuk River	2	8.0	86	688	18,770
Sadlerochit River	3	10.6	75	795	35,690
Sadlerochit River	4	9.0	165	1,485	26,390
Sadlerochit River	5	7.8	230	1,794	72,440
Sadlerochit River	6	3.0	50	150	140
Jago River	7	5.1	60	306	170
Okerokovik River	8	3.4	95	323	0
Okerokovik River	9	4.8	110	528	0

Table 7.—Data summary of ice hummock inventory by drainage system (Elliott and Lyons 1990).

Drainage	Miles of River Surveyed	Ice Hummocks Observed (N)	Estimated Volume (gal)
Canning River	35	138	1,861,000
Tamayariak River	34	45	483,100
Katakturuk River	23	60	829,200
Sadlerochit River	20	121	3,237,300
Hulahula River	25	165	2,100,600
Okpilak River	31	10	25,600
Jago River	69	65	447,400
TOTAL	237	604	8,939,200

the coastal plain of the Arctic NWR. The results of the lake surface water elevation survey conducted by Global Positioning Services (1993) were better than anticipated. The horizontal control exceeded the minimum requirement of 1:100,000. The least accurate horizontal control was better than

1:219,000,with the average horizontal control for the project of 1:800,000. This high degree of accuracy exceeded the specifications and standards of the Federal Geodetic Control Committee as outlined in the Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques. (Global Positioning Services 1993). Ellipsoidal height differences were less than five (5) centimeters with the majority having 2 centimeter accuracy. One hundred and twelve of the 150 lakes were lakes sampled by Trawicki et al. (1991) for lake water depth and volume. Lake numbers in the survey report (Global Positioning Services, Inc. 1993) coincide with those of Trawicki et al. (1991).

DISCUSSION and RECOMMENDATIONS

The North Slope of Alaska is a vast remote region with an abundance of natural resources. Due to the extreme climatic conditions and limited access the extent of the natural resources is largely unknown. As resource demands increase and technology advances, the natural resources along the North Slope will become economically and technologically accessible.

There has been little interest by State, Federal or private sector in the water resources along the coastal plain primarily because of a lack of competitive uses. The potential for oil and gas exploration along the coastal plain of the Arctic NWR resulted in a water resource inventory and assessment. The intent of the inventory and assessment is to provide resource managers with the hydrologic information required to make informed water allocation decisions concerning industrial development, mitigation measures, and fish and wildlife habitat protection.

The water resource studies conducted along the coastal plain of the Arctic NWR (1987-1992) provide a hydrologic database that will aid in resource management decisions. The studies provide a general understanding of the hydrologic regime and the physical processes that occur along this portion of the coastal plain. In general, breakup is the most significant hydrologic event of the year for streams that originate in the coastal plain. In most years more than 50 percent of the average annual discharge occurs during the breakup period. Streamflow quickly diminishes once snowmelt is complete. Summer discharge is low on most streams and in the absence of storm events discharge will go to zero on many streams. The presence of permafrost reduces infiltration resulting in quick stream response to storm events. Storm peaks are high and rapid, and recede quickly. Figure 2, is a generalized hydrograph for streams along the coastal plain. (Note that the hydrograph is from mid-May through mid-October.) Most years there was an increase in discharge just prior to freeze-up. The increase in discharge was due to snowfall followed by warmer temperatures and/or rain. By late September flow has diminished and ice has begun to form. With the exception of isolated pools and springs, rivers freeze to substrate. Lakes located along the coastal plain tend to be small shallow thaw lakes congregated near the mouth of the Canning River or west of the Okpilak River. Lakes less than 7 feet in depth generally freeze to substrate.

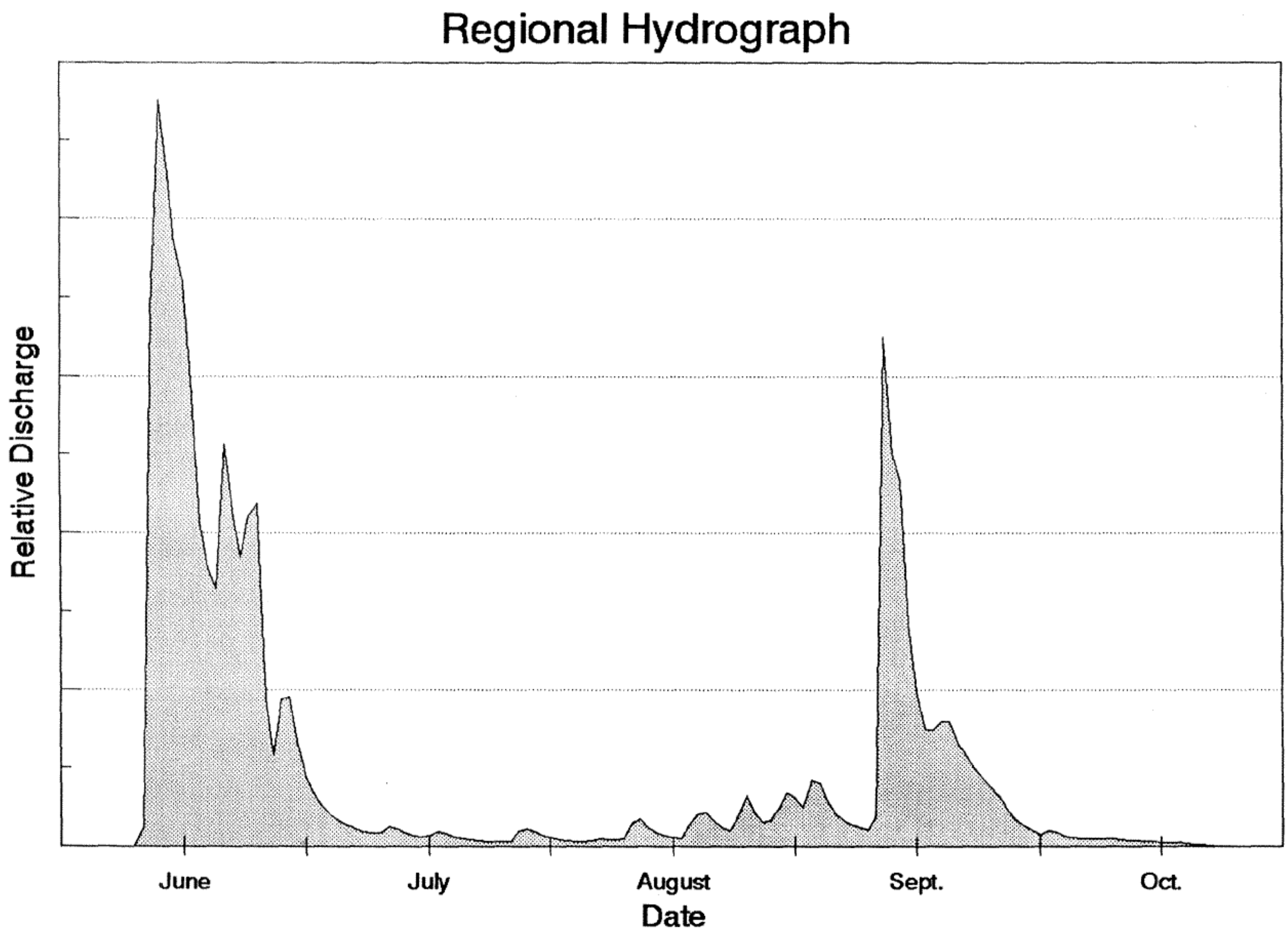

Figure 2.—Regional hydrograph for the streams of the coastal plain area, Arctic National Wildlife Refuge, Alaska.

The average daily discharges reported in Appendix A are considered to be good. With the short period of record (5 years) statistical analysis is limited, but the five years of stream discharge data collected along the coastal plain of the Arctic NWR are representative of the longterm average annual discharge. Comparing the 1988 through 1992 average annual discharge of the Kuparuk and Sagavanirktok Rivers with the longterm average annual discharge of these rivers, indicate that the five (5) years of discharge data for the coastal plain area of the Arctic NWR are representative of the expected long term average annual discharge of the coastal plain. The 5 years (1988 to 1992) were 2 percent below and 6.5 percent above the long term average annual discharge of the Kuparuk and Sagavanirktok Riversrespectively. During the five (5) years there was considerable variation in discharge. In 1989, the Kuparuk and Sagavanirktok Rivers were considerably higher than their long term average, 60 percent and 18 percent respectively. The converse occurred in 1990. The Kuparuk River was 35 percent below the average long term annual discharge while the Sagavanirktok River was 15 percent below. These trends are evident on the streams of the coastal plain of the Arctic NWR. The annual hydrograph of the Tamayariak River (Figure 3) is representative of the variation among the five (5) years of data.

Breakup data for the gaged streams located on the coastal plain of the Arctic NWR have been estimated. These estimates are considered to be poor, but are the best available. During breakup the normal relationship between water surface elevation (depth) and discharge does not always hold true. Initially, water from the melting snow flows over thick layers of river ice. The water flowing over ice creates a temporary and extremely high water surface elevation. Once the ice has eroded from the channel the relationship between water depth and discharge can be established. Stream gaging stations were not installed until river channels were ice free.

Estimates for missing data, other than for breakup, were made using existing data from gaging stations located within the coastal plain, Arctic NWR. These estimates are also considered to be poor. USGS stream gaging stations are located too far from the streams of the coastal plain area of the Arctic NWR to be used to estimate local rainfall events.

The distribution and timing of water is critical for the management of resources located along the coastal plain of the Arctic NWR. The water resource data in this report provide information required to make management decisions, but are by no means conclusive. In the planning stages of resource development along the coastal plain additional water resource data will be required. It is recommended that stream gaging stations be installed on the Canning River, Hulahula River, Okpilak River and the Jago River prior to development. These rivers were identified as high priority streams but were not gaged due to logistical and technical restraints. The Hulahula, and Canning Rivers have significant resource and recreational values. There are several spring areas associated with each river. These spring areas provide overwintering habitat for Arctic char populations. The Hulahula River is also used for subsistence purposes by the residence of Kaktovik.

The Kogopak River was also identified as high priority during the scoping process, but data for this stream can be synthesized and a gage is not

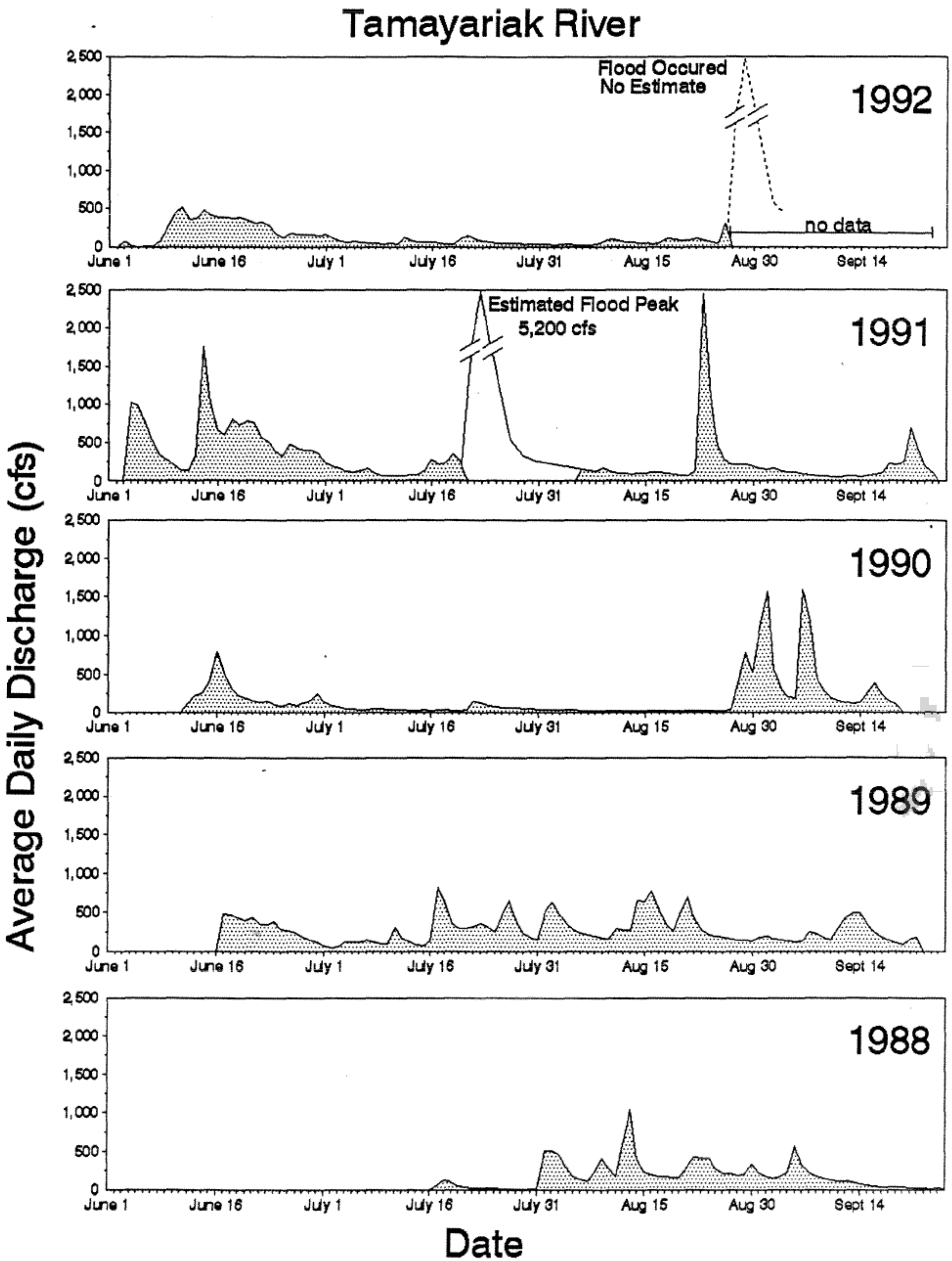

Figure 3.-Comparison of discharge records for the Tamayariak River for the 5 years of record, 1988-1992.

required. Gages could also be reinstalled on the Tamayariak River, Sadlerochit River, Akutoktak River, and the Sikrelurak River to augment the existing database. It is also recommended that summer and winterprecipitation data be collected in the headwaters and along the coastal plain. The new and additional data would increase the existing database and allow for a more rigorous statistical analysis.

Since many biologic processes are dependent on the hydrologic cycle it is recommended that the U.S. Fish and Wildlife Service secure instream water rights on the streams, springs, wetlands, and lakes along the coastal plain of the Arctic NWR. Water resources are limited 10 months of the year. Thelittle water that is available during the winter and the low flow summer periods provide the only available aquatic habitat. The relatively high flows associated with breakup provide the water necessary for fish passage in and out of the streams, and provide the volume of water required to establish the salinity and temperature gradients in the estuaries and lagoons.

Regular and periodic flooding are an integral part of the hydrologic cycle and are required to maintain the longterm functional integrity of most ecosystem. Ninety-nine percent of the coastal plain of the Arctic NWR is classified as wetland (Clough et al. 1987) with the majority falling into the palustrine system (moist tundra)(National Wetland Inventory, unpublished). Based on this classification almost the entire watershed for all drainages in the coastal plain area, Arctic NWR are a moist tundra system. The river systems themselves are a dominating factor influencing the physical characteristics of the riverine and estuarine wetland systems. Temporary and/or occasional flooding is required to maintain the functional integrity of these wetland systems. Instream water rights need to incorporate flood flows on a periodic basis for the purpose of maintaining the stream and connected habitats. Securing instream water rights at the present time would be prudent of the Service and alleviate future conflict with respect to water allocation.

The topographic relief on the western portion of the study area is distinctly different from the Prudhoe Bay region and the eastern portion of the 1002 area. The topographic relief prohibits the formation of thaw lakes. Except for region with topograpic relief, thaw lakes generally provide a more abundant source of winter water than naturally occurring water pools in springs and rivers. Should oil and gas development occur along the coastal plain of the Arctic NWR the topographic relief will present engineering problems different from those of Prudhoe Bay. Roads and/or pipelines that run east and west will cross several drainages and will run perpendicular to the slope of the landscape. It is recommended that bridges be required at all stream crossings to handle storm and breakup flows, and ice flowing in the stream channel. Roads running perpendicular to the slope of the landscape will create a barrier to sheetflow during breakup and storm events. To maintain the integrity of the wetlands, road culverts (18" or larger) should be located at a minimum of every 1,000 ft. and at all natural depression or drainage.

The physical and biological process in the Arctic ecosystem are dynamic. For every change in the physical environment there is a biological response.

Managing to maintain the functional integrity of the Arctic ecosystem and providing for its socioeconomic use is and will continue to be a challenge. The intent of this report was to provide resource managers with information required to make resource management decisions along the coastal plain of the Arctic NWR.

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Appendix A

Surface Water Discharge Records

Akutoktak River

LOCATION.--Lat 69°49.97′ N., long 143°46.83′ W., in center sec. 36, T.6N., R.33E., Umiat Meridian, 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--97.1 mi², of which 66 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR THE PERIOD OF RECORD.--Maximum Discharge, 119 cfs Aug. 23, 1988 @ 0830 hrs; Minimum Discharge, 4.7 cfs Sept. 25, 1988 @ 0645 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	20 e	5.6	36
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	20 e	5.5	29
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	20 e	6.1	34
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	20 e	8.0	60
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	10 e	7.4	89
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	10 e	6.8	74
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	230 e	10 e	6.5	58
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	810 e	10 e	8.5	43
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1000 e	10 e	31	32
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	920 e	10 e	65	24
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	870 e	10 e	43	19
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	750 e	10 e	29	16
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	630 e	10 e	28	14
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	530 e	10 e	22	14
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	420 e	10 e	16	12
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	360 e	10 e	13	11
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	290 e	10 e	18	10
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	230 e	10 e	18	9.2
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	170 e	10 e	17	8.7
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	130 e	8.0	18	8.7
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	100 e	8.0	23	9.2
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	150 e	80 e	7.6	63	8.7
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	150 e	70 e	7.8	111	8.0
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	60 e	8.5	104	7.6
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	50 e	8.3	76	6.5
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	50 e	7.6	55	5.9
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	40 e	7.0	46	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	30 e	6.6	43	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	80 e	30 e	6.3	39	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	80 e	20 e	5.9	46	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	80 e	---	6.1	47	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1230	8400	318	1023	648
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	95	280	10	33	25
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150	1000	20	111	89
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30	20	5.9	5.5	5.9
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.97	2.88	0.11	0.34	0.26
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.47	3.22	0.12	0.39	0.25
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2440	16661	630	2029	1286

TOTAL	11619	TOTAL RUNOFF (AC-FT)	23046
MEAN (MAY 19 TO SEP 26)	89	AVERAGE RUNOFF (CFSM)	0.91
SEVEN-DAY LOW FLOW	6.03	TOTAL RUNOFF (INCHES)	4.45
INSTANTANEOUS PEAK FLOW	119 e (Aug. 23, 1988)		

NOTE: e = ESTIMATE

Akutoktak River

LOCATION.--Lat 69°49.97′ N., long 143°46.83′ W., in center sec. 36, T.6N., R.33E., Umiat Meridian, 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--97.1 mi^2, of which 66 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Data gap (July 26 to Aug. 12) caused by equipment malfunction. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,703 cfs Aug. 20, 1989 @ 2350 hrs; Minimum Discharge, 2.2 cfs July 6-7, 1989.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	430 e	7.7	---	---
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	510 e	5.9	---	---
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	600 e	3.5	---	---
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	680 e	3.8	---	---
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	770 e	2.8	---	---
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	850 e	2.4	---	---
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	940 e	2.8	---	---
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1020 e	4.1	---	---
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	600 e	5.5	---	---
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	500 e	6.9	---	---
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	360 e	23	---	---
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	44	---	---
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220 e	27	66	---
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	190 e	16	608	---
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	187	10	549	---
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	143	10	392	---
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	105	290	349	---
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	74	344	223	---
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	52	146	138	---
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	48	114	251	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	42	235	---	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	37	469	---	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	45	295	---	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	48	719	---	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	46	444	---	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	42	---	---	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	29	---	---	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	20	---	---	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	14	---	---	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	10	---	---	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	---	---	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8862	3231	2576	---
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	295	129	---	---
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1020	719	608	---
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	2.4	66	---
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.04	1.33	---	---
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.39	1.24	---	---
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17578	6409	5109	---

TOTAL	14669		TOTAL RUNOFF (AC-FT)	29096
MEAN (JUN 6 TO AUG 20)	233		AVERAGE RUNOFF (CFSM)	2.40
SEVEN-DAY LOW FLOW	3.57		TOTAL RUNOFF (INCHES)	5.62
INSTANTANEOUS PEAK FLOW	1703	(Aug. 20, 1989)		

NOTE: e = ESTIMATE

Akutoktak River

LOCATION.--Lat 69°49.97′ N., long 143°46.83′ W., in center sec. 36, T.6N., R.33E., Umiat Meridian, 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--97.1 mi², of which 66 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,703 cfs Aug. 20, 1989 @ 2350 hrs; Minimum Discharge, 0.7 cfs Aug. 18, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	5.8	3.0	19
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	5.1	2.4	27
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	4.2	1.8	20
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	3.0	1.7	15
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	8.0 e	2.4	1.6	12
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	7.0 e	1.7	1.4	23
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	6.0 e	1.4	1.7	60
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	5.0 e	1.4	1.6	52
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	5.0 e	1.6	1.3	36
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	4.0 e	1.8	1.2	24
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	5.0 e	2.4	1.1	19
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	6.0 e	2.4	1.0	16
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	8.9	2.2	1.0	13
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	11	1.7	0.93	11
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	10	1.4	0.86	15
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	9.4	1.1	0.80	21
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	14	1.6	0.80	17
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1360 e	48	1.7	1.2	11
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	560 e	44	1.6	5.1	8.1
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	370 e	134	1.6	4.5	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	280 e	118	1.4	4.8	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	210 e	99	3.2	4.8	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	160 e	64	2.8	4.8	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	46	1.6	3.9	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	35	1.3	3.0	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	22	1.1	2.4	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	15	1.0	2.0	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	11	4.5	2.4	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	30 e	8.5	8.1	9.4	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	20 e	6.9	5.4	10	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	20 e	---	3.9	11	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3370	802	80	94	420
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	241	27	3	3	22
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1360	134	8	11	60
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20	6.9	1.0	0.80	8.1
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.48	0.28	0.03	0.03	0.23
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.29	0.31	0.03	0.04	0.16
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6684	1591	159	187	833

TOTAL	4767		TOTAL RUNOFF (AC-FT)	9454
MEAN (MAY 18 TO SEP 19)	38		AVERAGE RUNOFF (CFSM)	0.39
SEVEN-DAY LOW FLOW	0.93		TOTAL RUNOFF (INCHES)	1.83
INSTANTANEOUS PEAK FLOW	215	(June 20, 1990)		

NOTE: e = ESTIMATE

Akutoktak River

LOCATION.--Lat 69°49.97′ N., long 143°46.83′ W., in center sec. 36, T.6N., R.33E., Umiat Meridian, 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--97.1 mi², of which 66.0 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,703 cfs Aug. 20, 1989 @ 2350 hrs; Minimum Discharge, 0.7 cfs Aug. 18, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	600 e	62	63	10
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1230 e	50	45	8.2
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	630 e	32	34	7.3
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	566	22	28	6.9
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	395	14	29	7.3
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	194	10	26	5.4
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	124	8.7	20	4.7
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	73	7.1	19	5.0
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50	4.9	19	5.0
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40	4.5	23	4.7
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	31	3.8	18	4.4
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	58	3.8	15	4.7
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	308	3.8	12	5.4
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	597	3.8	55	4.4
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	451	3.1	96	5.0
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	296	4.5	100	4.2
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	3.0 e	284	3.8	80	76
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	6.0 e	348	3.8	60	532
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	256	53	47	318
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	227	44	37	200
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	169	37	29	213
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	124	60	25	298
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	76	314	30	226
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	64	236	44	141
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	150 e	43	122	43	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	160 e	53	71	34	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	170 e	163	47	26	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	100	36	21	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	260 e	61	33	17	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	320 e	46	29	14	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	420 e	---	63	11	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2219	7657	1389	1118	2094
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	148	255	45	36	87
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	420	1230	314	100	532
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	31	3.1	11	4.2
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.52	2.63	0.46	0.37	0.90
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.85	2.93	0.53	0.43	0.80
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4401	15188	2755	2218	4154

TOTAL	14478		TOTAL RUNOFF (AC-FT)	28717
MEAN (MAY 17 TO SEP 24)	111		AVERAGE RUNOFF (CFSM)	1.14
SEVEN-DAY LOW FLOW	3.77		TOTAL RUNOFF (INCHES)	5.55
INSTANTANEOUS PEAK FLOW	768	(June 14, 1991)		

NOTE: e = ESTIMATE

Akutoktak River

LOCATION.--Lat 69°49.97′ N., long 143°46.83′ W., in center sec. 36, T.6N., R.33E., Umiat Meridian, 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--97.1 mi², of which 66.0 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991; and June to Sept. 1992.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,818 cfs Aug. 27, 1992 @ 1200 hrs; Minimum Discharge, 0.7 cfs Aug. 18, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	630 e	9.9	8.8	122
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	590 e	11	7.5	122
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	470 e	15	22	132
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	340 e	13	34	132
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	290 e	9.9	36	109
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	270 e	8.1	26	95
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	420 e	6.5	19	83
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	350 e	5.5	16	73
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	302	4.8	33	64
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	345	4.5	53	53
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	359	4.3	36	40
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	154	5.2	25	29
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	95	16	27	22
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	154	19	40	17
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	157	15	57	12
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	105	11	51	16
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	73	8.8	41	15
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	54	6.8	70	11
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	42	5.7	67	8.5
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	32	5.2	47	7.1
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	26	5.0	35	6.3
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	22	6.0	28	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	18	7.5	22	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	15	6.8	19	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	14	7.1	17	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	14	7.8	31	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20	25	943	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	19	29	652	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	560 e	14	19	383	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	780 e	11	14	233	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	710 e	---	11	162	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2070	5403	322	3240	1167
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	518	180	10	105	56
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	780	630	29	943	132
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	11	4.3	7.5	6.3
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.33	1.85	0.11	1.08	0.57
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.79	2.07	0.12	1.24	0.45
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4106	10716	639	6425	2316

TOTAL	12202		TOTAL RUNOFF (AC-FT)	24202
MEAN (MAY 28 TO SEP 21)	104		AVERAGE RUNOFF (CFSM)	1.07
SEVEN-DAY LOW FLOW	5.57		TOTAL RUNOFF (INCHES)	4.67
INSTANTANEOUS PEAK FLOW	1818	(Aug. 27, 1992)		

NOTE: e = ESTIMATE

Itkilyariak Creek, West Fork

LOCATION.--Lat 69°50.31′ N., long 144°24.71′ W., NE¼NW¼ sec. 33, T.6N., R.31E., Umiat Meridian, 0.6 miles upstream from the confluence with the Itkilyariak Creek, 20.75 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--26.9 mi², of which 8.7 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--June to Sept. 1989.

REMARKS.--This is a 3rd Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Stream normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,419 cfs Aug. 20, 1989; Minimum Discharge, 0 cfs July 2-6, 1989.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	4.0	29	80
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	2.1	35	46
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	0.0	139	45
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	0.0	251	40
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	0.0	92	32
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	2.1	54	36
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	6.6	42	56
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	7.4	35	40
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	4.5	29	29
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	4.5	25	25
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	59	26	26
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	20	26	31
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	14	37	45
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	11	409	48
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	61	8.0	176	40
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	78	18	184	27
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	52	218	122	20
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	34	98	63	15
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	34	41	40	15
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	27	31	300	11
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	24	35	554	12
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	18	41	139	9.2
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	15	33	59	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	21	29	37	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	27	61	34	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	13	251	31	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	10	320	30	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	7.7	92	27	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	90 e	6.6	44	27	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	120 e	4.9	28	26	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	120 e	---	23	67	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	380	1253	1506	3145	728
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12	42	49	101	33
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120	90	320	554	80
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	25.0	9.2
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.46	1.55	1.81	3.77	1.23
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.53	1.73	2.08	4.35	1.01
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	754	2486	2988	6238	1444

TOTAL	7012		TOTAL RUNOFF (AC-FT)	13909
MEAN (MAY 27 TO SEP 22)	59		AVERAGE RUNOFF (CFSM)	2.19
SEVEN-DAY LOW FLOW	1.88		TOTAL RUNOFF (INCHES)	9.69
INSTANTANEOUS PEAK FLOW	1419	(Aug. 20, 1989)		

NOTE: e = ESTIMATE

Itkilyariak Creek, West Fork

LOCATION.--Lat 69°50.31′ N., long 144°24.71′ W., NE¼NW¼ sec. 33, T.6N., R.31E., Umiat Meridian, 0.6 miles upstream from the confluence with the Itkilyariak Creek, 20.75 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--26.9 mi², of which 8.7 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

REMARKS.--This is a 3rd Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Stream normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,419 cfs Aug. 20, 1989; Minimum Discharge, 0 cfs July 2-6, 1989, and July 13-16, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	4.5	5.4	73
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	3.4	3.7	40
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	3.0	3.0	28
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	2.7	4.9	21
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	2.1	6.8	20
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	1.4	4.9	110
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	1.4	3.7	165
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	1.9	3.4	97
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	2.1	3.0	59
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	1.6	2.7	40
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	1.0	2.4	31
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	43	0.5	2.1	26
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1.0 e	81	0.1	1.9	21
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	3.0 e	47	0.0	1.6	21
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	8.0 e	28	0.1	1.6	50
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	32	1.0	4.1	64
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1260 e	26	1.2	4.5	33
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	890 e	30	1.4	3.7	19
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	710 e	66	1.4	3.7	14
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	410 e	89	0.6	3.7	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	280 e	44	0.8	4.1	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	230 e	53	21	3.7	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	30	25	3.0	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	170 e	20	16	2.1	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	12	9.5	1.6	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	7.8	49	1.2	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	6.8	42	1.4	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	5.8	16	20.6	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	60 e	4.9	11	14.8	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	50 e	5.4	8.9	12.7	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	50 e	---	6.8	18.8	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4802	890	237	155	934
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	155	30	7.6	5.0	49
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1260	89	49	21	165
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	1.2	14.1
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.76	1.10	0.30	0.21	1.83
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.64	1.23	0.33	0.21	1.29
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9525	1766	469	308	1853

TOTAL	7019		TOTAL RUNOFF (AC-FT)	13921
MEAN (MAY 13 TO SEP 19)	54		AVERAGE RUNOFF (CFSM)	2.01
SEVEN-DAY LOW FLOW	0.53		TOTAL RUNOFF (INCHES)	9.70
INSTANTANEOUS PEAK FLOW	160	(June 19, 1990)		

NOTE: e = ESTIMATE

Itkilyariak Creek, West Fork

LOCATION.--Lat 69°50.31′ N., long 144°24.71′ W., NE¼NW¼ sec. 33, T.6N., R.31E., Umiat Meridian, 0.6 miles upstream from the confluence with the Itkilyariak Creek, 20.75 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--26.9 mi², of which 8.7 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 3rd Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data due to equipment damage during flood event. Stream normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,419 cfs Aug. 20, 1989; Minimum Discharge, 0 cfs July 2-6, 1989, and July 13-16, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	770 e	30	---	19
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1120 e	19	---	17
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	830 e	14	---	10
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	440 e	11	11	8.4
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	8.1	11	7.9
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	8.1	13	6.5
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	155	8.1	14	4.8
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	111	8.1	11	4.4
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90	6.5	16	4.1
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70	6.5	17	3.1
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	61	6.5	11	3.7
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70	6.5	7.9	2.2
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	178	8.1	6.1	2.8
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	241	6.5	5.2	2.5
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	170 e	6.0	5.6	3.4
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	11	7.4	2.5
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	8.1	7.9	137
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1.0 e	178	8.1	7.9	177
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	5.0 e	144	14	6.1	105
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	144	8.1	4.8	64
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	122	37	4.1	102
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	100	---	14	100
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	70	---	173	56
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	52	---	115	29
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	37	---	64	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	80	---	40	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	150 e	70	---	29	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	52	---	29	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	250 e	44	---	31	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	340 e	37	---	26	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	480 e	---	---	22	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2026	6046	239	710	872
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	145	202	11	25	36
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	480	1120	37	173	177
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37	6.0	4.1	2.2
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.38	7.49	0.42	0.94	1.34
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.80	8.36	0.33	0.98	1.21
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4019	11992	475	1408	1730

TOTAL	9894		TOTAL RUNOFF (AC-FT)	19624
MEAN (MAY 18 TO SEP 24)	85		AVERAGE RUNOFF (CFSM)	3.14
SEVEN-DAY LOW FLOW	2.89		TOTAL RUNOFF (INCHES)	13.68
INSTANTANEOUS PEAK FLOW	276	(June 14, 1991)		

NOTE: e = Estimated

Itkilyariak Creek, West Fork

LOCATION.--Lat 69°50.31′ N., long 144°24.71′ W., NE¼NW¼ sec. 33, T.6N., R.31E., Umiat Meridian, 0.6 miles upstream from the confluence with the Itkilyariak Creek, 20.75 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--26.9 mi², of which 8.7 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990; June to Sept. 1991; and June to Sept. 1992.

REMARKS.--This is a 3rd Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data due to bear damage (7/8/92 to 8/6/92), and equipment malfunction (8/10/92 to 8/13/92). Stream normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,419 cfs Aug. 20, 1989; Minimum Discharge, 0 cfs July 2-6, 1989, and July 13-16, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	710 e	16	---	54
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	24	---	55
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	18	---	47
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	33	16	---	41
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	27	15	---	37
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	24	16	---	35
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	18	17	3.7	33
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	74	---	4.9	30
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	142	---	14	27
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	247	---	---	19
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	204	---	---	20
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	101	---	---	16
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	59	---	---	16
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	49	---	12	14
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	37	---	17	10
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	29	---	12	9.1
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	24	---	19	9.5
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20	---	78	13
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	18	---	45	11
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	16	---	33	11
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	13	---	27	9.1
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	12	---	20	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	12	---	16	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	9.8	---	14	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	7.7	---	13	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	24	---	32	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	49	---	679	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	25	---	270	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	710 e	18	---	185	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	1110 e	15	---	118	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	970 e	---	---	71	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2790	2325	121	1682	513
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	930	78	---	80	24
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1110	710	24	679	55
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	15	3.7	9.1
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.6	2.88	---	2.98	0.91
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.86	3.21	---	2.32	0.71
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5534	4612	240	3335	1018

TOTAL	7431		TOTAL RUNOFF (AC-FT)	14740
MEAN (MAY 29 TO SEP 21)	91		AVERAGE RUNOFF (CFSM)	3.37
SEVEN-DAY LOW FLOW	---		TOTAL RUNOFF (INCHES)	10.27
INSTANTANEOUS PEAK FLOW	1255	(Aug. 27, 1992)		

NOTE: e = Estimated

Niguanak River

LOCATION.--Lat 70°0.58′ N., Long 143°1.9 W.′, NW¼NW¼NE¼ sec. 36, T.8N., R.36E., Umiat Meridian, 6 miles upstream from the mouth, 16.5 mi south-east of Kaktovik, Alaska.

DRAINAGE AREA.--136.2 mi^2.

PERIOD OF RECORD.--June to Sept. 1989.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 2,071 cfs Aug. 21, 1989 @ 0310 hrs; Minimum Discharge, 3.3 cfs July 3, 1989 @ 1805 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	520 e	44	61	266
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	630 e	38	60	266
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	730 e	18	67	573
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	740 e	44	107	581
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	940 e	89	94	346
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1050 e	60	75	367
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1150 e	140	64	297
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1260 e	50	59	160
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1360 e	30	55	105
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1230 e	34	50	115
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1050 e	71	52	362
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	750 e	42	57	413
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	580 e	27	60	395
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	597	30	203	657
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	491	43	311	557
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	550	109	266	341
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	279	82	234	227
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	227	30	193	163
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	158	51	147	166
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	123	56	320	119
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	187	79	1,148	117
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	150	67	413	111
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	109	57	288	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	147	69	227	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	137	53	231	---
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	109	145	166	---
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94	311	160	---
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	63	199	187	---
29	0.0	0.0	0.0	0.0	---	0.0	0.0	---	53	109	180	---
30	0.0	0.0	0.0	0.0	---	0.0	0.0	---	84	94	203	---
31	0.0	---	0.0	0.0	---	0.0	---	---	---	81	246	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	15548	2352	5984	6704
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	518	76	193	305
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	1360	311	1148	657
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	53	18	50	105
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	3.81	0.56	1.42	2.24
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	4.25	0.64	1.63	1.83
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	30839	4665	11869	13297

TOTAL	30588		TOTAL RUNOFF (AC-FT)	60670
MEAN (JUN 9 TO SEP 22)	259		AVERAGE RUNOFF (CFSM)	1.90
SEVEN-DAY LOW FLOW	39.50		TOTAL RUNOFF (INCHES)	8.35
INSTANTANEOUS PEAK FLOW	2071	(AUG. 21, 1989)		

NOTE: e = ESTIMATED

Niguanak River

LOCATION.--Lat 70°0.58' N., Long 143°1.9 W.', NW¼NW¼NE¼ sec. 36, T.8N., R.36E., Umiat Meridian, 6 miles upstream from the mouth, 16.5 mi south-east of Kaktovik, Alaska.

DRAINAGE AREA.--136.2 mi².

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Bear disturbed instrument July 13, 1990. River normally freezes to to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 2,071 cfs Aug. 21, 1989 @ 0310 hrs; Minimum Discharge, 0 cfs Aug. 2, 7, 10-27, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	50 e	21	1 e	16 e
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	40 e	17	0 e	29 e
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	40 e	14	1 e	39 e
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	30 e	13	1 e	37 e
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	20 e	8 e	1 e	37 e
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	20 e	5 e	1 e	84 e
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	20 e	5 e	0 e	200 e
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	20 e	3 e	1 e	155 e
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	20 e	5 e	1 e	115 e
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	71	4 e	0 e	87 e
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	87	4 e	0 e	66 e
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	78	3 e	0 e	50 e
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	135	2 e	0 e	37 e
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	160 e	138	2 e	0 e	29 e
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220 e	138	1 e	0 e	25 e
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	570 e	107	1 e	0 e	22 e
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2540 e	92	2 e	0 e	19 e
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2110 e	94	2 e	0 e	16 e
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1310 e	89	1 e	0 e	13 e
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1090 e	92	1 e	0 e	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	820 e	92	1 e	0 e	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	630 e	94	5 e	0 e	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	490 e	94	6 e	0 e	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	380 e	64	2 e	0 e	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	290 e	52	1 e	0 e	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	48	1 e	0 e	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	34	1 e	0 e	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	34	1 e	1 e	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	90 e	32	1 e	1 e	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	80 e	26	1 e	1 e	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	60 e	---	1 e	3 e	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11530	1949	136	16	1076
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	549	65	---	---	---
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2540	138	21	1	200
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26	0.7	0.0	---
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.03	0.48	---	---	---
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.15	0.53	---	---	---
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22869	3867	269	31	2134

TOTAL	14707	TOTAL RUNOFF (AC-FT)	29170
MEAN (MAY 11 TO SEP 19)	111	AVERAGE RUNOFF (CFSM)	0.82
SEVEN-DAY LOW FLOW	0.00	TOTAL RUNOFF (INCHES)	4.02
INSTANTANEOUS PEAK FLOW	---		

NOTE: e = ESTIMATED

Niguanak River

LOCATION.--Lat 70°0.58′ N., Long 143°1.9 W.′, NW¼NW¼NE¼ sec. 36, T.8N., R.36E., Umiat Meridian, 6 miles upstream from the mouth, 16.5 mi south-east of Kaktovik, Alaska.

DRAINAGE AREA.--136.2 mi^2.

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Bear disturbed instrument July 13, 1990. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 2,071 cfs Aug. 21, 1989 @ 0310 hrs; Minimum Discharge, 0 cfs Aug. 2, 7, 10-27, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1710 e	200	52	9.3
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2000 e	175	45	8.5
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1800 e	148	36	7.8
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1150 e	117	26	6.4
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	780 e	82	23	3.4
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	520 e	100	37	3.8
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	370 e	117	29	5.2
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	280 e	77	28	3.8
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220 e	67	26	5.2
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	240 e	54	21	3.8
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	390 e	43	17	3.4
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	620 e	41	15	4.7
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1114	48	16	4.7
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1281	59	18	3.8
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1114	87	20	3.8
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	888	106	21	4.7
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	781	109	21	16
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	946	87	16	117
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	867	79	11	196
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	410 e	765	95	10	283
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	470 e	654	120	9.3	339
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	550 e	525	193	15	480 e
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	590 e	352	515	23	350 e
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	630 e	308	366	28	250 e
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	650 e	215	219	28	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	660 e	246	132	23	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	700 e	326	103	17	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	760 e	361	77	14	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	870 e	339	65	13	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	950 e	308	63	11	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	1230 e	---	56	9.3	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8840	21471	3802	678	2114
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	589	716	123	22	88
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1230	2000	515	52	480
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	215	41	9.3	3.4
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.33	5.25	0.90	0.16	0.65
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.41	5.86	1.04	0.19	0.58
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17534	42586	7540	1346	4193

TOTAL	36904	TOTAL RUNOFF (AC-FT)	73199
MEAN (MAY 17 TO SEP 24)	282	AVERAGE RUNOFF (CFSM)	2.07
SEVEN-DAY LOW FLOW	4.11	TOTAL RUNOFF (INCHES)	10.08
INSTANTANEOUS PEAK FLOW	1319 (June 14, 1991)		

NOTE: e = Estimate

Niguanak River

LOCATION.--Lat 70°0.58′ N., Long 143°1.9 W.′, NW¼NW¼NE¼ sec. 36, T.8N., R.36E., Umiat Meridian, 6 miles upstream from the mouth, 16.5 mi south-east of Kaktovik, Alaska.

DRAINAGE AREA.--136.2 mi^2.

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990; June to Sept. 1991; and June to Sept. 1992.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data beginning July 7, 1992 due to equipment malfunction. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 2,071 cfs Aug. 21, 1989 @ 0310 hrs; Minimum Discharge, 0 cfs Aug. 2, 7, 10-27, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	890 e	203	---	---
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	500 e	140	---	---
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	340 e	100	---	---
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	150 e	92	---	---
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	171	116	---	---
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	123	105	---	---
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110	103	---	---
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	230	---	---	---
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	689	---	---	---
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	717	---	---	---
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1109	---	---	---
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	710	---	---	---
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	446	---	---	---
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	337	---	---	---
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	273	---	---	---
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	227	---	---	---
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	241	---	---	---
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	265	---	---	---
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	273	---	---	---
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	253	---	---	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	216	---	---	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220	---	---	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	174	---	---	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110	---	---	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	90	---	---	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	90	---	---	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	96	---	---	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	190 e	159	---	---	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	1310 e	227	---	---	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	1570 e	189	---	---	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	1480 e	---	---	---	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3070	9623	859	---	---
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	321	---	---	---
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1570	1109	203	---	---
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90	92	---	---
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	2.36	---	---	---
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	2.63	---	---	---
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6089	19087	1703	---	---

TOTAL	---	TOTAL RUNOFF (AC-FT)	---
MEAN	---	AVERAGE RUNOFF (CFSM)	---
SEVEN-DAY LOW FLOW	---	TOTAL RUNOFF (INCHES)	---
INSTANTANEOUS PEAK FLOW	---		

NOTE: e = Estimate

Sadlerochit River

LOCATION.--Lat 69°38' N., long 144° 22.83' W., in NW¼SW¼ sec. 31, T.4N., R.32E., Umiat Meridian, 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.--520.1 mi², of which 517.5 mi² is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi² depending on existing climatic conditions.

PERIOD OF RECORD.--July to Sept. 1988.

REMARKS.--This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data (July 28 to Aug. 15) was caused by a loose electrical connector. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 2,194 cfs Aug. 22, 1988 @ 1900 hrs; Minimum Discharge, 70.2 cfs Sept. 27, 1988 @ 1145 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	660
2	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	601
3	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	571
4	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	547
5	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	577
6	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	520
7	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	464
8	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	398
9	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	331
10	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	285
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	254
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	229
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	208
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	185
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	170
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	978	159
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	928	139
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	873	132
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	828	122
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	811	116
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	846	1495	110
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	702	1937	101
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	607	1840	95
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	520	1450	92
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	454	1130	92
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	385	928	84
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	342	828	76
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	---	747	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	---	695	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	---	811	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	---	771	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	3856	17052	7316
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	---	---	271
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	846	1937	660
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	342	695	76
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	---	---	0.50
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	---	---	0.10
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	7649	33822	14512

TOTAL	28224		TOTAL RUNOFF (AC-FT)	---
MEAN (JUL 21 TO SEP 27)	---		AVERAGE RUNOFF (CFSM)	---
SEVEN-DAY LOW FLOW	92.91		TOTAL RUNOFF (INCHES)	---
INSTANTANEOUS PEAK FLOW	2194	(Aug. 22, 1988)		

NOTE: e = ESTIMATE

Sadlerochit River

LOCATION.--Lat 69°38′ N., long 144° 22.83′ W., in NW¼SW¼ sec. 31, T.4N., R.32E., Umiat Meridian, 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.--520.1 mi^2, of which 517.5 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi^2 depending on existing climatic conditions.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989.

REMARKS.--This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 5,733 cfs Aug. 4, 1989 @ 1545 hrs; Minimum Discharge, 70.2 cfs Sept. 27, 1988 @ 1145 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1275	894	904
2	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1013	1742	982
3	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	775	1881	829
4	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	649	4385	740
5	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	749	3411	673
6	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	866	2286	602
7	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	923	1853	572
8	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1173	1608	784
9	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1275	1455	649
10	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1129	1298	536
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1217	1151	501
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2147	1054	820
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1530	1003	962
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1275	1151	1118
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1162	3053	943
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1107	2563	723
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2350	2193	565
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	4124	1825	448
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1240	2698	1430	359
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	923	1797	1173	255
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1151	1811	1997	234
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1582	2664	2366	176
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2056	2579	1492	158
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2012	2027	1096	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	3315	2178	885	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2613	2132	913	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1783	2962	820	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1595	2546	749	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	1530	1595	657	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	1369	1162	625	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	943	572	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	21169	51833	49581	14533
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	1672	1599	632
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	3315	4124	4385	1118
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	923	649	572	158
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	3.20	3.10	1.20
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	3.70	3.60	1.00
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	41988	102809	98342	28826

TOTAL	137116		TOTAL RUNOFF (AC-FT)	271966
MEAN (JUN 19 TO SEP 23)	1414		AVERAGE RUNOFF (CFSM)	2.72
SEVEN-DAY LOW FLOW	313.63		TOTAL RUNOFF (INCHES)	9.80
INSTANTANEOUS PEAK FLOW	5733	(Aug. 4, 1989)		

NOTE: e = ESTIMATE

Sadlerochit River

LOCATION.--Lat 69°38' N., long 144° 22.83' W., in NW¼SW¼ sec. 31, T.4N., R.32E., Umiat Meridian, 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.--520.1 mi², of which 517.5 mi² is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi² depending on existing climatic conditions.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 5,733 cfs Aug. 4, 1989 @ 1545 hrs; Minimum Discharge, 70.2 cfs Sept. 27, 1988 @ 1145 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1416	597	692
2	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1255	584	476
3	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1119	537	346
4	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1055	506	---
5	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	983	470	---
6	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	954	426	---
7	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	944	394	---
8	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	887	374	---
9	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	798	355	---
10	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	---	756	341	---
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	177	708	337	---
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	200	700	337	---
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	459	781	337	---
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	557	993	360	---
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1065	1267	399	---
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2578	1044	436	---
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1889	896	447	---
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2678	815	442	---
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2052	764	447	---
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2520	732	442	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1328	748	410	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1550	1429	374	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1086	1429	337	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	869	1174	307	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	740	983	282	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	773	1044	271	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	896	896	351	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1550	708	662	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	1634	633	655	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	2069	670	500	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	---		647	662	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	26668	29232	13381	1514
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	1333	943	432	---
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	2678	1429	662	692
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	177	633	271	346
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	2.60	1.80	0.83	---
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	1.90	2.10	1.00	---
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	52803	57879	26493	3004

TOTAL	70795		TOTAL RUNOFF (AC-FT)	140419
MEAN (JUN 11 TO SEPT 3)	833		AVERAGE RUNOFF (CFSM)	1.60
SEVEN-DAY LOW FLOW	333.05		TOTAL RUNOFF (INCHES)	5.06
INSTANTANEOUS PEAK FLOW	4857	(June 18, 1990)		

NOTE: e = ESTIMATE

Sadlerochit River

LOCATION.--Lat 69°38′ N., long 144° 22.83′ W., in NW¼SW¼ sec. 31, T.4N., R.32E., Umiat Meridian, 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.--520.1 mi², of which 517.5 mi² is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi² depending on existing climatic conditions.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data (July 21 to Aug. 4) due to equipment problem due to flood event. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 21,000 cfs July 21, 1991; Minimum Discharge, 39 cfs Sept. 15, 1991 @ 1413 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2324	---	442
2	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1775	---	460
3	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1432	---	424
4	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1304	1195	---	376
5	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1583	987	819	334
6	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1291	909	1092	294
7	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	844	1050	1020	227
8	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	543	844	872	235
9	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	430	648	812	188
10	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	371	554	614	148
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	374	475	523	156
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	389	421	479	120
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	365	401	620	124
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	792	399	919	78
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1028	433	763	83
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	918	543	784	148
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	768	538	698	368
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1932	835	620	446
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2584	1641	528	433
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2921	1060	465	415
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	3305	9200	380	631
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	3621	---	608	685
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	3067	---	1732	484
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2880	---	887	355
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2097	---	655	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	3715	---	538	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	3239	---	470	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	2527	---	442	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	2642	---	442	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	2880	---	451	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	---	451	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	48412	27665	18684	7657
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	1793	1317	692	319
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	3715	9190	1732	685
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	365	399	380	78
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	3.45	2.53	1.33	0.61
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	3.46	1.98	1.34	0.55
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	96024	54873	37059	15187

TOTAL	102417		TOTAL RUNOFF (AC-FT)	203142
MEAN (JUN 4 TO SEP 24)	1035		AVERAGE RUNOFF (CFSM)	1.99
SEVEN-DAY LOW FLOW	122.67		TOTAL RUNOFF (INCHES)	7.32
INSTANTANEOUS PEAK FLOW	21000	(July 21, 1991)		

NOTE: e = ESTIMATE

Sadlerochit River

LOCATION.--Lat 69°38' N., long 144° 22.83' W., in NW¼SW¼ sec. 31, T.4N., R.32E., Umiat Meridian, 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.--520.1 mi², of which 517.5 mi² is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi² depending on existing climatic conditions.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991; and June to Sept. 1992.

REMARKS.--This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data due to equipment failure (July 31 to Aug. 5). River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 21,000 cfs JULY 21, 1991; Minimum Discharge, 39 cfs Sept. 15, 1991 @ 1413 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1520	1941	1300 e	1303
2	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1736	1564	1160 e	1407
3	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1189	1199	1035 e	1233
4	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	407	1049	940 e	999
5	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	359	995	822	807
6	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	227	926	722	678
7	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	123	851	692	567
8	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	219	795	775	479
9	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1329	771	1109	399
10	---	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1520	787	964	275
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2614	986	830	258
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2415	2185	767	206
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2055	1575	767	180
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1759	1040	767	139
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1531	803	807	122
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1654	667	692	109
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2093	625	642	99
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2198	632	685	80
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2029	681	567	78
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1867	2485	491	67
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1979	2251	503	69
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2106	1423	567	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1954	1412	503	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1759	1381	415	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1487	1991	362	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2185	5197	1428	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2004	5656	4216	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	1444	4317	2380	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	1520	2471	2023	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	1620	1643	1683	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	1085	---	1465 e	1449	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	46901	51762	32067	9552
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	1563	1670	1034	455
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	2614	5656	4216	1407
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	123	625	362	67
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	3.01	3.21	1.99	0.87
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	3.35	3.70	2.29	0.68
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	93027	102667	63603	18946

TOTAL	141366		TOTAL RUNOFF (AC-FT)	280395
MEAN (JUN 1 TO SEP 21)	1240		AVERAGE RUNOFF (CFSM)	2.38
SEVEN-DAY LOW FLOW	88.97		TOTAL RUNOFF (INCHES)	10.11
INSTANTANEOUS PEAK FLOW	9506	(July 26, 1992)		

NOTE: e = ESTIMATE

Sadlerochit Spring Creek

LOCATION.--Lat 69°39.88' N., long 144°24.87' W., NE¼NW¼ sec. 36, T.4N., R.31E., Umiat Meridian, 3000 ft. downstream of Sadlerochit Spring, 37.5 mi. southwest of Kaktovik, Alaska.

DRAINAGE AREA.--0.5 mi².

PERIOD OF RECORD.--July to Dec. 1988.

REMARKS.--This is a 2nd Order drainage with 2 springs contributing most of the flow.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 55 cfs Aug. 16 & 19, 1988 @ 1115 hrs; Minimum Discharge, 28 cfs Aug. 15, 1988 @ 1815 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	40 e	39 e	37 e	35 e	32 e	30 e	29 e	29 e	33 e	40 e	37	44
2	40 e	39 e	37 e	35 e	32 e	30 e	29 e	29 e	33 e	40 e	38	44
3	40 e	39 e	37 e	35 e	32 e	30 e	29 e	29 e	33 e	40 e	38	44
4	40 e	39 e	37 e	35 e	32 e	30 e	29 e	29 e	33 e	40 e	38	43
5	40 e	39 e	37 e	35 e	32 e	30 e	29 e	29 e	34 e	40 e	38	43
6	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	34 e	40 e	38	45
7	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	35 e	40 e	38	46
8	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	35 e	40 e	38	45
9	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	35 e	40 e	40	44
10	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	36 e	40 e	43	44
11	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	36 e	40 e	41	43
12	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	37 e	40 e	40	44
13	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	37 e	40 e	41	44
14	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	38 e	39 e	38	44
15	40 e	38 e	36 e	34 e	32 e	30 e	29 e	29 e	38 e	39 e	40	44
16	39 e	37 e	35 e	33 e	31 e	30 e	28 e	29 e	39 e	39 e	41	44
17	39 e	37 e	35 e	33 e	31 e	30 e	28 e	29 e	39 e	39 e	41	44
18	39 e	37 e	35 e	33 e	31 e	30 e	28 e	29 e	40 e	39 e	42	44
19	39 e	37 e	35 e	33 e	31 e	30 e	28 e	29 e	40 e	39 e	43	43
20	39 e	37 e	35 e	33 e	31 e	30 e	28 e	29 e	40 e	39 e	41	43
21	39 e	37 e	35 e	33 e	31 e	29 e	28 e	30 e	40 e	38 e	41	43
22	39 e	37 e	35 e	33 e	31 e	29 e	28 e	30 e	40 e	38	42	44
23	39 e	37 e	35 e	33 e	31 e	29 e	28 e	30 e	40 e	38	44	43
24	39 e	37 e	35 e	33 e	31 e	29 e	28 e	30 e	40 e	38	44	42
25	39 e	37 e	35 e	33 e	31 e	29 e	28 e	30 e	40 e	38	44	42
26	39 e	37 e	35 e	33 e	31 e	29 e	28 e	31 e	40 e	38	43	43
27	39 e	37 e	35 e	33 e	31 e	29 e	28 e	32 e	40 e	38	43	42
28	39 e	37 e	35 e	33 e	31 e	29 e	28 e	32 e	40 e	37	43	42
29	39 e	37 e	35 e	33 e	31 e	29 e	28 e	32 e	40 e	37	43	42
30	39 e	37 e	35 e	33 e	---	29 e	28 e	32 e	40 e	36	43	42
31	39 e	---	35 e	33 e	---	29 e	---	32 e	---	37	44	---
TOTAL	1224	1130	1105	1043	914	919	855	921	1125	1210	1264	1295
MEAN	39	38	36	34	32	30	29	30	38	39	41	43
MAX	40	39	37	35	32	30	29	32	40	40	44	46
MIN	39	37	35	33	31	29	28	29	33	37	37	42
AC-FT	2428	2241	2192	2069	1813	1823	1696	1827	2231	2401	2507	2568

ANNUAL TOTAL	13005		ANNUAL RUNOFF (AC-FT)	25795
ANNUAL MEAN	36		ANNUAL RUNOFF (CFSM)	---
ANNUAL SEVEN-DAY LOW FLOW	28		ANNUAL RUNOFF (INCHES)	967
INSTANTANEOUS PEAK FLOW	55	(Aug. 16 & 19, 1988)		

NOTE: e = ESTIMATED

Sadlerochit Spring Creek

LOCATION.--Lat 69°39.88′ N., long 144°24.87′ W., NE¼NW¼ sec. 36, T.4N., R.31E., Umiat Meridian, 3000 ft. downstream of Sadlerochit Spring, 37.5 mi. southwest of Kaktovik, Alaska.

DRAINAGE AREA.--0.5 mi².

PERIOD OF RECORD.--July to Dec. 1988; June to Sept. 1989.

REMARKS.--This is a 2nd Order drainage with 2 springs contributing most of the flow.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 108 cfs Aug. 20, 1989 @ 1345 hrs; Minimum Discharge, 28 cfs Aug. 15, 1988 @ 1815 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	42	40	38	35 e	32 e	30 e	29 e	29 e	32 e	42	50	81
2	42	40	38	35 e	32 e	30 e	29 e	29 e	33 e	42	46	81
3	41	38	38	35 e	32 e	30 e	29 e	29 e	33 e	42	54	81
4	41	38	37	35 e	32 e	30 e	29 e	29 e	33 e	42	48	79
5	41	38	38	35 e	32 e	30 e	29 e	29 e	34 e	40	46	79
6	42	38	38	34 e	32 e	30 e	29 e	29 e	34 e	42	46	79
7	41	38	37	34 e	32 e	30 e	29 e	29 e	34 e	42	46	79
8	41	38	36	34 e	32 e	30 e	29 e	29 e	35 e	40	48	79
9	41	38	36	34 e	32 e	30 e	29 e	29 e	35 e	38	48	79
10	41	38	38	34 e	32 e	30 e	29 e	29 e	35 e	44	48	79
11	40	38	37	34 e	32 e	30 e	29 e	29 e	36 e	50	50	81
12	41	38	37	34 e	32 e	30 e	29 e	29 e	36 e	40	52	81
13	41	38	38	34 e	32 e	30 e	29 e	29 e	36 e	40	56	85
14	41	38	36	34 e	32 e	30 e	29 e	29 e	37 e	40	60	83
15	41	38	35	34 e	32 e	30 e	29 e	29 e	37 e	42	56	81
16	41	40	36	33 e	31 e	30 e	28 e	29 e	37 e	48	60	81
17	41	40	35	33 e	31 e	30 e	28 e	29 e	38 e	52	58	79
18	42	38	35	33 e	31 e	30 e	28 e	29 e	38	42	58	79
19	41	38	35	33 e	31 e	30 e	28 e	29 e	40	44	58	79
20	40	38	35	33 e	31 e	30 e	28 e	29 e	38	46	81	79
21	41	38	36	33 e	31 e	29 e	28 e	30 e	38	42	67	79
22	41	40	36	33 e	31 e	29 e	28 e	30 e	38	42	62	77
23	41	38	35	33 e	31 e	29 e	28 e	30 e	40	50	62	76 e
24	41	38	35	33 e	31 e	29 e	28 e	30 e	42	48	62	75 e
25	40	38	35	33 e	31 e	29 e	28 e	30 e	42	44	64	75 e
26	38	38	35 e	33 e	31 e	29 e	28 e	31 e	42	48	64	74 e
27	40	38	35 e	33 e	31 e	29 e	28 e	32 e	42	38	67	73 e
28	40	38	35 e	33 e	31 e	29 e	28 e	32 e	42	40	67	73 e
29	41	38	35 e	33 e	---	29 e	28 e	32 e	42	46	71	72 e
30	40	38	35 e	33 e	---	29 e	28 e	32 e	42	46	73	71 e
31	40	---	35 e	33 e	---	29 e	---	32 e	---	46	81	---
TOTAL	1252	1159	1130	1043	883	919	855	921	1121	1348	1809	2349
MEAN	40	39	36	34	32	30	29	30	37	43	58	78
MAX	42	40	38	35	32	30	29	32	42	52	81	85
MIN	38	38	35	33	31	29	28	29	32	38	46	71
AC-FT	2484	2300	2241	2069	1751	1823	1696	1827	2223	2674	3588	4659

ANNUAL TOTAL	14789		ANNUAL RUNOFF (AC-FT)	29334
ANNUAL MEAN	41		ANNUAL RUNOFF (CFSM)	---
ANNUAL SEVEN-DAY LOW FLOW	28		ANNUAL RUNOFF (INCHES)	1100
INSTANTANEOUS PEAK FLOW	108	(Aug. 20, 1989)		

NOTED: e = ESTIMATED

Sadlerochit Spring Creek

LOCATION.--Lat 69°39.88′ N., long 144°24.87′ W., NE¼NW¼ sec. 36, T.4N., R.31E., Umiat Meridian, 3000 ft. downstream of Sadlerochit Spring, 37.5 mi. southwest of Kaktovik, Alaska.

DRAINAGE AREA.--0.5 mi².

PERIOD OF RECORD.--July to Dec. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 2nd Order drainage with 2 springs contributing most of the flow.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 108 cfs Aug. 20, 1989 @ 1345 hrs; Minimum Discharge, 28 cfs Aug. 15, 1988 @ 1815 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	71 e	52 e	37 e	35 e	32 e	30 e	29 e	29 e	36 e	40	36	36
2	70 e	51 e	37 e	35 e	32 e	30 e	29 e	29 e	36 e	39	36	36
3	70 e	51 e	37 e	35 e	32 e	30 e	29 e	29 e	36 e	39	36	36
4	69 e	50 e	37 e	35 e	32 e	30 e	29 e	29 e	37 e	39	36	36
5	68 e	49 e	37 e	35 e	32 e	30 e	29 e	29 e	37 e	39	36	36
6	68 e	49 e	36 e	34 e	32 e	30 e	29 e	29 e	37 e	39	36	37
7	67 e	48 e	36 e	34 e	32 e	30 e	29 e	29 e	38 e	39	36	37
8	67 e	47 e	36 e	34 e	32 e	30 e	29 e	29 e	38 e	39	36	37
9	66 e	47 e	36 e	34 e	32 e	30 e	29 e	29 e	38 e	38	36	37
10	65 e	46 e	36 e	34 e	32 e	30 e	29 e	29 e	39 e	38	36	37
11	65 e	46 e	36 e	34 e	32 e	30 e	29 e	29 e	39	36	36	38
12	64 e	45 e	36 e	34 e	32 e	30 e	29 e	29 e	40	36	36	39
13	63 e	44 e	36 e	34 e	32 e	30 e	29 e	30 e	40	36	36	39
14	63 e	44 e	36 e	34 e	32 e	30 e	29 e	30 e	40	36	36	38
15	62 e	43 e	36 e	34 e	32 e	30 e	29 e	30 e	40	36	36	37
16	62 e	43 e	35 e	33 e	31 e	30 e	28 e	31 e	40	36	36	36
17	61 e	42 e	35 e	33 e	31 e	30 e	28 e	31 e	40	36	36	37
18	60 e	41 e	35 e	33 e	31 e	30 e	28 e	31 e	40	36	36	37
19	60 e	41 e	35 e	33 e	31 e	30 e	28 e	31 e	40	36	36	37
20	59 e	40 e	35 e	33 e	31 e	30 e	28 e	32 e	40	36	36	38 e
21	59 e	39 e	35 e	33 e	31 e	29 e	28 e	32 e	40	36	36	38 e
22	58 e	39 e	35 e	33 e	31 e	29 e	28 e	32 e	40	36	36	38 e
23	57 e	38 e	35 e	33 e	31 e	29 e	28 e	33 e	40	37	36	38 e
24	57 e	37 e	35 e	33 e	31 e	29 e	28 e	33 e	40	37	35	38 e
25	56 e	37 e	35 e	33 e	31 e	29 e	28 e	33 e	40	37	35	38 e
26	55 e	37 e	35 e	33 e	31 e	29 e	28 e	34 e	40	36	36	38 e
27	55 e	37 e	35 e	33 e	31 e	29 e	28 e	34 e	40	36	36	38 e
28	54 e	37 e	35 e	33 e	31 e	29 e	28 e	34 e	40	36	36	38 e
29	54 e	37 e	35 e	33 e	---	29 e	28 e	35 e	40	36	36	38 e
30	53 e	37 e	35 e	33 e	---	29 e	28 e	35 e	40	36	35	37 e
31	52 e	---	35 e	33 e	---	29 e	---	35 e	---	36	36	---
TOTAL	1910	1294	1105	1043	883	919	855	964	1172	1152	1110	1117
MEAN	62	43	36	34	32	30	29	31	39	37	36	37
MAX	71	52	37	35	32	30	29	34	40	40	36	40
MIN	54	37	35	33	31	29	28	29	36	36	35	36
AC-FT	3789	2566	2192	2069	1751	1823	1696	1912	2324	2285	2203	2216

ANNUAL TOTAL	13524		ANNUAL RUNOFF (AC-FT)	26825
ANNUAL MEAN	37		ANNUAL RUNOFF (CFSM)	---
ANNUAL SEVEN-DAY LOW FLOW	28		ANNUAL RUNOFF (INCHES)	1006
INSTANTANEOUS PEAK FLOW	41	(Aug. 18 & 19, 1990)		

NOTE: e = ESTIMATED

Sadlerochit Spring Creek

LOCATION.--Lat 69°39.88′ N., long 144°24.87′ W., NE¼NW¼ sec. 36, T.4N., R.31E., Umiat Meridian, 3000 ft. downstream of Sadlerochit Spring, 37.5 mi. southwest of Kaktovik, Alaska.

DRAINAGE AREA.--0.5 mi².

PERIOD OF RECORD.--July to Dec. 1988; June to Sept. 1989; June to Sept. 1990; and June to Sept. 1992.

REMARKS.--This is a 2nd Order drainage with 2 springs contributing most of the flow.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 108 cfs Aug. 20, 1989 @ 1345 hrs; Minimum Discharge, 28 cfs Aug. 15, 1988 @ 1815 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	37 e	36 e	35 e	34 e	32 e	30 e	29 e	29 e	36 e	40	45	46
2	37 e	36 e	35 e	34 e	32 e	30 e	29 e	29 e	36 e	40	45	46
3	37 e	36 e	35 e	34 e	32 e	30 e	29 e	29 e	36 e	40	45	46
4	37 e	36 e	35 e	34 e	32 e	30 e	29 e	29 e	36	40	45	46
5	37 e	36 e	35 e	34 e	32 e	30 e	29 e	29 e	36	40	45	46
6	37 e	36 e	35 e	33 e	32 e	30 e	29 e	29 e	36	40	45	47
7	37 e	36 e	35 e	33 e	32 e	30 e	29 e	29 e	36	40	45	47
8	37 e	36 e	35 e	33 e	32 e	30 e	29 e	29 e	38	40	45	47
9	37 e	36 e	35 e	33 e	32 e	30 e	29 e	29 e	38	40	45	47
10	37 e	36 e	35 e	33 e	32 e	30 e	29 e	29 e	38	41	45	47
11	37 e	36 e	35 e	33 e	32 e	30 e	29 e	29 e	38	41	45	47
12	37 e	36 e	34 e	33 e	32 e	30 e	29 e	29 e	38	42	45	47
13	37 e	36 e	34 e	33 e	32 e	30 e	29 e	30 e	38	41	45	47
14	37 e	36 e	34 e	33 e	32 e	30 e	29 e	30 e	38	41	46	47
15	37 e	36 e	34 e	33 e	32 e	30 e	29 e	30 e	38	41	46	47
16	37 e	36 e	34 e	33 e	32 e	30 e	28 e	31 e	38	41	45	47
17	37 e	36 e	34 e	33 e	32 e	30 e	28 e	31 e	38	41	47	47
18	37 e	35 e	34 e	33 e	32 e	30 e	28 e	31 e	38	42	46	47
19	37 e	35 e	34 e	33 e	32 e	30 e	28 e	31 e	38	42	45	47
20	37 e	35 e	34 e	33 e	32 e	30 e	28 e	32 e	38	43	45	47
21	37 e	35 e	34 e	33 e	32 e	29 e	28 e	32 e	38	43	45	47
22	37 e	35 e	34 e	33 e	32 e	29 e	28 e	32 e	38	43	45	46 e
23	37 e	35 e	34 e	33 e	32 e	29 e	28 e	33 e	38	43	45	46 e
24	36 e	35 e	34 e	33 e	31 e	29 e	28 e	33 e	38	43	45	45 e
25	36 e	35 e	34 e	33 e	31 e	29 e	28 e	33 e	39	43	45	45 e
26	36 e	35 e	34 e	33 e	31 e	29 e	28 e	34 e	39	45	46	45 e
27	36 e	35 e	34 e	33 e	31 e	29 e	28 e	34 e	40	44	51	45 e
28	36 e	35 e	34 e	33 e	31 e	29 e	28 e	34 e	40	45	46	45 e
29	36 e	35 e	34 e	33 e	---	29 e	28 e	35 e	40	44	45	45 e
30	36 e	35 e	34 e	32 e	---	29 e	28 e	35 e	40	45	45	44 e
31	36 e	---	34 e	32 e	---	29 e	---	35 e	---	45	46	---
TOTAL	1141	1067	1064	1025	891	919	855	964	1133	1298	1408	1383
MEAN	37	36	34	33	31	30	29	31	38	42	45	46
MAX	37	36	35	34	32	30	29	34	40	45	51	47
MIN	36	35	34	33	31	29	28	29	36	40	45	44
AC-FT	2263	2116	2110	2032	1768	1823	1696	1912	2247	2574	2792	2742

ANNUAL TOTAL	13146		ANNUAL RUNOFF (AC-FT)	26075
ANNUAL MEAN	36		ANNUAL RUNOFF (CFSM)	---
ANNUAL SEVEN-DAY LOW FLOW	28		ANNUAL RUNOFF (INCHES)	978
INSTANTANEOUS PEAK FLOW	61	(Aug. 27, 1992)		

NOTED: e = ESTIMATED

Sikrelurak River

LOCATION.--Lat 69°54.71′ N., Long 142°30.87′ W., SE¼SE¼ sec. 36, T.7N., R.38E., Umiat Meridian, at the confluence with the West Fork Sikrelurak River, 31 mi south-east of Katktovik, Alaska.

DRAINAGE AREA.--74.7 mi².

PERIOD OF RECORD.--June to Sept. 1989.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 282 cfs Aug. 20 and 21, 1989; Minimum Discharge, 0 cfs July 20, 1989.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	510 e	10	22	64
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	610 e	8.6	20	66
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	710 e	4.0 e	34	154
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	820 e	26	62	176
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	920 e	26	51	120
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1,020 e	26	41	87
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1,120 e	25	32	70
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1220 e	12	26	56
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	710 e	10	21	49
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	590 e	11	18	42
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	420 e	16	15	89
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	290 e	8.6	13	107
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220 e	6.3	14	112
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	148	5.0	74	151
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	125	5.6	92	157
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	109	3.2	89	101
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	89	6.3	83	66
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	62	5.0	70	51
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	44	3.8	56	36
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	39	1.7	128	27
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	42	5.6	235	18
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	36	19	151	12
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	33	20	99	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	34	18	72	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	27	16	74	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	32	39	66	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	26	72	58	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	24	60	51	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	19	45	49	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	16	34	51	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	26	60	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	10065	575	1927	1811
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	336	19	62	82
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	1220	72	235	176
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	16	1.7	13	12
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	4.49	0.25	0.83	1.10
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	5.03	0.29	0.96	0.90
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	19964	1140	3822	3592

TOTAL	14378		TOTAL RUNOFF (AC-FT)	28518
MEAN (JUN 8 TO SEP 22)	126		AVERAGE RUNOFF (CFSM)	1.69
SEVEN-DAY LOW FLOW	4.38		TOTAL RUNOFF (INCHES)	7.16
INSTANTANEOUS PEAK FLOW	282	(Aug. 20, 1989)		

NOTE: e = ESTIMATED

Sikrelurak River

LOCATION.--Lat 69°54.71′ N., Long 142°30.87′ W., SE¼SE¼ sec. 36, T.7N., R.38E., Umiat Meridian, at the confluence with the West Fork Sikrelurak River, 31 mi south-east of Katktovik, Alaska.

DRAINAGE AREA.--74.7 mi².

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 282 cfs Aug. 20 and 21, 1989; Minimum Discharge, 0 cfs July 20, 1989, August 14-28, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	9.2	0.4	7.8
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	8.5	0.2	14
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	8.5	0.4	19
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	5.3	0.5	18
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	9 e	4.3	0.5	18
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	8 e	3.8	0.4	41
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	7 e	2.2	0.2	97
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	6 e	2.9	0.4	75
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	5 e	2.5	0.4	56
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	5 e	2.2	0.2	42
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	29	1.8	0.2	32
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	38	1.5	0.2	24
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	47	1.2	0.2	18
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	46	1.0	0.1	14
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	44	0.7	0.1	12
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	35	0.5	0.1	11
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	31	1.0	0.0	9.2
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1630 e	34	1.0	0.0	7.8
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	660 e	31	0.5	0.1	6.5
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	440 e	34	0.4	0.0	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	320 e	32	0.5	0.0	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	240 e	31	2.5	0.0	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	190 e	29	2.9	0.0	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	21	1.2	0.0	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	20	0.7	0.0	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	17	0.7	0.0	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	15	0.5	0.0	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	17	0.4	0.5	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	30 e	15	0.4	0.7	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	30 e	11	0.4	0.7	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	20 e	---	0.4	1.5	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3970	665	70	8.4	523
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	284	22	2.2	0.3	28
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1630	47	9.2	1.5	97
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20	11	1.7	0.0	6.5
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.80	0.30	0.03	0.004	0.37
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.98	0.33	0.03	0.004	0.26
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7874	1319	138	17	1037

TOTAL	5236		TOTAL RUNOFF (AC-FT)	10386
MEAN (MAY 18 TO SEP 19)	42		AVERAGE RUNOFF (CFSM)	0.56
SEVEN-DAY LOW FLOW	0.00		TOTAL RUNOFF (INCHES)	2.61
INSTANTANEOUS PEAK FLOW	117	(Sept. 7, 1990)		

NOTE: e = ESTIMATED

Sikrelurak River

LOCATION.--Lat 69°54.71′ N., Long 142°30.87′ W., SE¼SE¼ sec. 36, T.7N., R.38E., Umiat Meridian, at the confluence with the West Fork Sikrelurak River, 31 mi south-east of Katktovik, Alaska.

DRAINAGE AREA.--74.7 mi².

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,787 cfs June 4, 1991 @ 2015 hr.; Minimum Discharge, 0 cfs July 20, 1989, August 14-28, 1990, and Septl 6-8, 1991.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	710 e	38	28	5.1
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1480 e	36	25	4.1
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	750 e	31	18	3.6
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	586	25	14	3.1
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	888	24	14	3.6
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	534	26	16	3.1
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	304	22	13	2.0
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	190	18	12	2.5
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	133	16	11	4.1
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	88	14	8.9	3.6
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80	13	8.4	6.2
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	138	13	7.8	4.1
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	359	14	10	5.1
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	578	16	8.9	6.2
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	447	17	8.9	8.9
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	343	18	10	7.8
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	3.0 e	289	15	8.9	11
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	6.0 e	308	14	6.2	40
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	234	14	4.6	80
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	186	14	4.6	133
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	136	39	4.6	146
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	92	47	8.9	158
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	150 e	68	118	11	111
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	160 e	55	98	14	79
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	44	70	15	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	51	55	14	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	68	46	11	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	240 e	61	40	10	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	310 e	58	36	7.8	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	380 e	44	33	6.7	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	500 e	---	31	5.7	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2629	9302	1012	344	832
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	175	310	33	11	35
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	500	1480	118	28	158
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	44	13	4.6	2.0
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.35	4.15	0.44	0.15	0.46
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.05	7.25	0.50	0.17	0.41
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5215	18450	2008	683	1649

TOTAL	14119		TOTAL RUNOFF (AC-FT)	28004
MEAN (MAY 17 TO SEP 24)	108		AVERAGE RUNOFF (CFSM)	1.44
SEVEN-DAY LOW FLOW	3.14		TOTAL RUNOFF (INCHES)	7.03
INSTANTANEOUS PEAK FLOW	1787	(June 4, 1991)		

NOTE: e = ESTIMATED

Sikrelurak River

LOCATION.--Lat 69°54.71′ N., Long 142°30.87′ W., SE¼SE¼ sec. 36, T.7N., R.38E., Umiat Meridian, at the confluence with the West Fork Sikrelurak River, 31 mi south-east of Katktovik, Alaska.

DRAINAGE AREA.--74.7 mi².

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990; June to Sept. 1991; and June to Sept. 1992.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data due to ground squirrel chewing cable (8/25/92 to 9/3/92). River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,787 cfs June 4, 1991 @ 2015 hr.; Minimum Discharge, 0 cfs July 20, 1989, August 14-28, 1990, and Septl 6-8, 1991.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	750 e	26	1.4	---
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	690 e	14	1.8	---
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	550 e	8.4	1.4	---
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	400 e	13	1.4	35
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	330 e	16	1.4	40
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	320 e	16	1.3	45
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	500 e	14	1.3	43
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	560 e	15	1.3	42
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	388	11	1.3	39
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	489	8.4	1.4	26
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	494	5.2	1.4	26
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	302	4.8	1.3	22
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	163	3.3	1.4	18
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	146	2.4	1.4	6.2
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	112	3.0	1.4	---
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	91	3.3	1.3	---
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	94	3.0	1.4	---
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	83	3.3	2.0	---
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	79	3.3	1.7 e	---
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	63	3.0	1.4	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	53	2.4	1.4	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50	2.2	1.3	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	31	2.0	1.3	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	19	2.0	1.3	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	17	1.7	---	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	15	1.5	---	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20	1.4	---	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	26	1.4	---	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	660 e	27	1.4	---	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	930 e	26	1.3	---	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	840 e	---	1.3	---	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2450	6888	195	34	342
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	613	767	6	1.4	31
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	930	930	26	2.0	45
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15	1.3	1.3	6.2
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	10.27	2.61	0.46	4.58
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	3.43	0.10	0.02	0.17
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4860	13662	387	67	678

TOTAL	9909		TOTAL RUNOFF (AC-FT)	19654
MEAN (MAY 28 TO SEP 14)	99		AVERAGE RUNOFF (CFSM)	1.33
SEVEN-DAY LOW FLOW	1.35		TOTAL RUNOFF (INCHES)	4.93
INSTANTANEOUS PEAK FLOW	1057	(June 10, 1992)		

NOTE: e = ESTIMATED

Tamayariak River

LOCATION.--Lat 69°49.97′ N., long 145°33.16′ W., in SW¼NE¼ sec. 35, T.6N., R.26E., Umiat Meridian, 11.8 miles upstream from the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--136.1 mi², which 56.8 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,996 cfs Aug. 12, 1988 @ 1445 hrs; Minimum Discharge, 11.8 cfs Sept. 26, 1988 @ 1300 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	480 e	140 e	508	181
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	460 e	130 e	508	156
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	460 e	120 e	459	184
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	460 e	120 e	307	233
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	460 e	110 e	177	569
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	470 e	100 e	136	331
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	470 e	100 e	120	227
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	480 e	90 e	225	175
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	480 e	90 e	410	148
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	480 e	80 e	289	133
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	490 e	80 e	175	121
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	820 e	80 e	583	111
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1400 e	80 e	1039	100
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1270 e	80 e	395	77
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1120 e	70 e	236	63
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1030 e	70 e	201	59
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	920 e	72	184	48
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	820 e	124	173	45
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	700 e	103	166	42
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	600 e	59	162	39
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	510 e	39	307	37
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	450 e	30	431	30
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	390 e	26	416	25
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	340 e	25	416	23
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	290 e	25	271	26
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	270 e	23	219	23
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	270 e	240 e	22	219	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	570 e	200 e	20	186	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	640 e	180 e	18	201	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	570 e	160 e	18	336	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	510 e	---	23	233	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2590	16900	2166	9687	3206
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	432	563	70	312	123
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	640	1400	140	1039	569
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	160	18	120	23
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.17	4.14	0.51	2.30	0.91
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.71	4.62	0.59	2.65	0.88
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5137	33521	4295	19214	6359

TOTAL	34549		TOTAL RUNOFF (AC-FT)	68526
MEAN (May 26 to Sept 26)	279		AVERAGE RUNOFF (CFSM)	2.05
SEVEN-DAY LOW FLOW	21.07		TOTAL RUNOFF (INCHES)	9.44
INSTANTANEOUS PEAK FLOW	1996	(Aug. 12, 1988)		

NOTE: e = ESTIMATED

Tamayariak River

LOCATION.--Lat 69°49.97′ N., long 145°33.16′ W., in SW¼NE¼ sec. 35, T.6N., R.26E., Umiat Meridian, 11.8 miles upstream from the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--136.1 mi², which 56.8 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,996 cfs Aug. 12, 1988 @ 1445 hrs; Minimum Discharge, 11.8 cfs Sept. 26, 1988 @ 1300 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	73	497	192
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	53	628	159
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	500 e	56	481	148
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	820 e	114	359	134
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1730 e	124	271	117
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2110 e	121	230	127
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2140 e	141	207	246
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1810 e	121	192	215
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1360 e	92	169	169
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1230 e	95	162	148
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1030 e	305	297	301
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	850 e	173	275	426
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	740 e	114	275	486
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	670 e	89	645	486
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	600 e	67	634	336
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	520 e	127	778	242
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	481	823	545	184
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	471	640	354	148
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	431	350	259	111
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	392	288	481	85
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	431	297	704	155
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	341	318	411	177
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	345	354	275	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	378	301	211	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	284	238	199	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	254	461	180	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	226	651	162	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	184	368	145	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	148	234	141	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	114	169	138	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	145	177	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	20870	7502	10482	4792
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	696	242	338	218
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	2140	823	778	486
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	114	53	138	85
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	5.11	1.78	2.48	1.60
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	5.70	2.05	2.86	1.31
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	41395	14880	20791	9505

TOTAL	43646		TOTAL RUNOFF (AC-FT)	86571
MEAN (JUN 1 TO SEP 22)	383		AVERAGE RUNOFF (CFSM)	2.81
SEVEN-DAY LOW FLOW	93.54		TOTAL RUNOFF (INCHES)	11.93
INSTANTANEOUS PEAK FLOW	997	(July 17, 1989)		

NOTE: e = ESTIMATED

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DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	190 e	133	38	1567
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	91	34	555
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	160 e	69	34	300
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	150 e	55	35	205
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	48	33	187
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	44	30	1588
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	41	29	1167
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	52	28	428
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	48	27	271
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	43	27	192
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	90 e	38	26	146
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	124	33	23	127
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	228	30	21	115
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	160 e	260	31	21	118
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220 e	412	33	21	260
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	570 e	794	32	26	382
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2540 e	535	33	32	233
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2110 e	313	33	30	149
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1310 e	228	31	29	102
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1050 e	187	30	29	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	900 e	153	33	30	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	770 e	136	146	29	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	670 e	153	118	28	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	590 e	105	86	27	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	500 e	93	71	24	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	410 e	107	61	24	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	330 e	88	67	44	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	300 e	130	62	420	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	260 e	160	53	781	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	180 e	249	45	516	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	210 e	---	41	1,100	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13310	5915	1731	3596	8092
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	634	197	56	116	426
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2540	794	146	1100	1588
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60	88	30	21	102
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.66	1.45	0.41	0.85	3.13
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.64	1.62	0.47	0.98	2.21
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26400	11732	3433	7132	16051

TOTAL	32644		TOTAL RUNOFF (AC-FT)	64748
MEAN (MAY 11 TO SEP 19)	247		AVERAGE RUNOFF (CFSM)	1.82
SEVEN-DAY LOW FLOW	23.57		TOTAL RUNOFF (INCHES)	8.92
INSTANTANEOUS PEAK FLOW	4099	(Sept. 6, 1990)		

NOTE: e = ESTIMATED

Tamayariak River

LOCATION.--Lat 69°49.97′ N., long 145°33.16′ W., in SW¼NE¼ sec. 35, T.6N., R.26E., Umiat Meridian, 11.8 miles upstream from the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data (July 23 to Aug. 5) due to lost of gaging station from flood event. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 5,200 cfs July 21, 1991; Minimum Discharge, 8.3 cfs Sept. 14, 1991 @ 1730 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1360 e	245	170 e	150
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2000 e	197	160 e	161
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1390 e	160	150 e	133
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1024	131	150 e	121
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	978	116	150 e	111
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	762	143	159	93
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	522	160	137	75
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	343	98	127	73
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	279	71	178	66
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	207	66	128	59
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	143	66	110	50
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	139	69	102	73
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	343	80	94	62
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1759	86	101	50
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1012	139	100	84
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	664	279	121	91
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	591	218	115	112
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	803	239	104	227
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	732	356	91	209
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	410 e	782	267	80	255
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	470 e	752	820 e	72	698
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	550 e	573	1350 e	142	440
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	590 e	498	1400 e	2442	206
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	630 e	391	560 e	1105	121
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	650 e	329	330 e	463	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	660 e	474	250 e	274	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	700 e	427	230 e	216	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	760 e	398	220 e	212	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	870 e	405	200 e	216	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	980 e	363	190 e	196	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	1120 e	---	190 e	166	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8760	20442	8925	7250	3720
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	584	681	288	279	155
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1120	2000	1400	2442	698
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	139	66	72	50
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.29	5.01	2.12	2.05	1.14
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.39	5.59	2.44	1.98	1.02
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17375	40546	17702	14380	7378

TOTAL	49876		TOTAL RUNOFF (AC-FT)	98928
MEAN (MAY 17 TO SEP 24)	381		AVERAGE RUNOFF (CFSM)	2.80
SEVEN-DAY LOW FLOW	62.13		TOTAL RUNOFF (INCHES)	13.63
INSTANTANEOUS PEAK FLOW	3244	(Aug. 22, 1991)		

NOTE: e = ESTIMATED

Tamayariak River

LOCATION.--Lat 69°49.97' N., long 145°33.16' W., in SW¼NE¼ sec. 35, T.6N., R.26E., Umiat Meridian, 11.8 miles upstream from the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991; and June to to Sept. 1992.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Flood of Aug. 27, 1992 caused significant channel scour. Stream discharge discontinued. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 5,200 cfs July 21, 1991; Minimum Discharge, 4.2 cfs June 5, 1992 @ 1040 hrs.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	890 e	154	31	---
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	500 e	103	28	---
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	336	69	29	---
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	143	57	30	---
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	109	70	28	---
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	171	59	26	---
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	119	48	25	---
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	350	42	29	---
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	624	40	78	---
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	927	43	94	---
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	1032	40	82	---
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	802	123	64	---
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	823	78	56	---
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	483	66	49	---
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	408	66	44	---
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	375	54	37	---
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	382	43	56	---
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	371	37	105	---
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	386	37	100	---
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	339	115	83	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	306	150	89	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	316	96	111	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	274	70	87	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	176	57	64	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	123	52	52	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0	166	47	303	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	161	45	---	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	190 e	154	43	---	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	1310 e	154	38	---	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	1570 e	143	34	---	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	1480 e	---	32	---	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4620	11543	2007	1777	---
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	924	385	65	68	---
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1570	1032	154	303	---
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	109	32	25	---
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.79	2.83	0.48	0.50	---
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.26	3.15	0.55	0.49	---
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9164	22895	3981	3525	---

TOTAL	19947		TOTAL RUNOFF (AC-FT)	39564
MEAN (MAY 27 TO AUG 26)	217		AVERAGE RUNOFF (CFSM)	1.59
SEVEN-DAY LOW FLOW	27.69		TOTAL RUNOFF (INCHES)	5.45
INSTANTANEOUS PEAK FLOW	2856	(Est. Aug. 27, 1992)		

NOTE: e = ESTIMATED

TAMAYARIAK RIVER, LOWER WEST FORK

LOCATION.--Lat 69°58.83′ N., long 145°47.67′ W., NW¼NW¼ sec 12, T.7N., R.25E., Umiat Meridian, 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--98.14 mi², of which 5.55 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate by the first week of October.

EXTREMES.--Maximum Discharge, 496 cfs Sept. 5, 1988 @ 1430 hrs; Minimum Discharge, 9.0 cfs August 6 & 7, 1988.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	40 e	11	98
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	40 e	10	65
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	40 e	11	68
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	30 e	10	100
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	30 e	10	364
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	260 e	30 e	9.4	249
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	260 e	20 e	10	141
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	330 e	20 e	42	89
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	390 e	20 e	79	57
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	390 e	20 e	191	45
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	550 e	20 e	122	38
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1380 e	20 e	156	33
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1220 e	20 e	392	31
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1050 e	20 e	194	31
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	890 e	20 e	110	27
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	770 e	20 e	81	26
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	660 e	17	73	24
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	550 e	16	59	23
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	440 e	15	56	23
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	350 e	15	60	23
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	280 e	15	141	22
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	230 e	15	306	21
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	190 e	14	249	19
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	160 e	15	249	26
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	14	149	18
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	110 e	13	106	30
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220 e	90 e	13	98	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	240 e	70 e	12	85	---
29	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	240 e	60 e	11	87	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	240 e	50 e	11	225	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	---	240 e	---	11	147	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1290	12100	616	3525	1689
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	215	403	20	114	65
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	240	1380	40	392	364
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110	50	11	9.4	18
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.19	4.11	0.20	1.16	0.66
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.49	4.59	0.23	1.34	0.64
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2559	24000	1223	6993	3349

TOTAL	19220		TOTAL RUNOFF (AC-FT)	38123
MEAN (MAY 26 TO SEP 26)	155		AVERAGE RUNOFF (CFSM)	1.58
SEVEN-DAY LOW FLOW	10.17		TOTAL RUNOFF (INCHES)	7.28
INSTANTANEOUS PEAK FLOW	496	(Sept. 5, 1988)		

NOTE: e = ESTIMATED

TAMAYARIAK RIVER, LOWER WEST FORK

LOCATION.--Lat 69°58.83′ N., long 145°47.67′ W., NW¼NW¼ sec 12, T.7N., R.25E., Umiat Meridian, 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--98.14 mi^2, of which 5.55 mi^2 are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES.--Maximum Discharge, 647 cfs Aug. 21, 1989 @ 0225 hrs; Minimum Discharge, 9.0 cfs August 6 & 7, 1988.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	40	198	105
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	36	391	85
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	170 e	36	308	82
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	550 e	41	205	78
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1880 e	41	136	61
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1660 e	39	100 e	49
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1780 e	38	90 e	57
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1770 e	30	90 e	66
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1170 e	27	75	54
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1010 e	28	62	48
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	780 e	32	90	121
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	590 e	26	125	235
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	480 e	23	134	217
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	470 e	22	287	270
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	450 e	20	238	205
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	440 e	25	285	134
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	419	43	235	87
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	314	110	144	59
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	287	134	96	43
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	233	129	183	38
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	248	108	477	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	172	110	217	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	159	98	123	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	181	76	79	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	119	59	61	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	98	121	57	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	84	345	52	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	69	181	47	---
29	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	55	101	44	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	47	64	47	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	---	---	---	47	72	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	15735	2230	4748	2094
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	525	115	153	105
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	1880	345	477	270
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	10	43	44	38
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	5.34	1.17	1.63	1.07
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	5.96	0.85	1.80	0.79
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	31210	4423	9400	4153

TOTAL	24807		TOTAL RUNOFF (AC-FT)	49204
MEAN (JUN 1 TO SEP20)	221		AVERAGE RUNOFF (CFSM)	2.26
SEVEN-DAY LOW FLOW	25.14		TOTAL RUNOFF (INCHES)	9.40
INSTANTANEOUS PEAK FLOW	647	(Aug 21, 1989)		

NOTE: e = ESTIMATED

TAMAYARIAK RIVER, LOWER WEST FORK

LOCATION.--Lat 69°58.83′ N., long 145°47.67′ W., NW¼NW¼ sec 12, T.7N., R.25E., Umiat Meridian, 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--98.14 mi², of which 5.55 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data (June 14 to July 9) due to animal chewing probe cable. River normally freezes to substrate the first week of October.

EXTREMES.--Maximum Discharge, 2,455 cfs Sept. 6, 1990 @ 2246 hrs; Minimum Discharge, 9.4 cfs August 6, 1988.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	20 e	6.1	219
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	10 e	5.8	460
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	10 e	5.5	284
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	20 e	5.2	202
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	10 e	5.2	154
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	10 e	4.9	758
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	10 e	4.6	1396
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	10 e	4.6	827
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	10 e	4.6	542
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	18	4.3	358
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	30	18	3.7	280
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	40	16	3.7	233
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	47	15	3.4	199
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	60 e	14	3.4	199
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	60 e	14	3.1	260
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	50 e	12	3.1	522
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	50 e	12	3.1	426
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2210 e	80 e	11	3.1	289
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1110 e	110 e	11	2.8	212
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	800 e	90 e	10	2.8	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	640 e	30 e	11	2.5	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	510 e	30 e	12	2.2	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	420 e	30 e	10	2.5	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	340 e	30 e	8.4	2.2	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	270 e	30 e	8.7	2.5	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	30 e	8.0	2.2	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	150 e	20 e	7.7	2.8	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	20 e	7.0	3.7	---
29	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	20 e	7.0	4.6	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	90 e	20 e	6.4	4.6	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	---	80 e	---	6.1	5.5	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7060	1276	352	118	7822
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	504	43	11	3.8	412
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2210	110	20	6.1	1396
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80	20	6.1	2.2	154
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.14	0.43	0.11	0.04	4.20
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.68	0.48	0.09	0.04	2.96
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14003	2532	479	233	15515

TOTAL	16628	TOTAL RUNOFF (AC-FT)	32981
MEAN (MAY 18 TO SEP 19)	133	AVERAGE RUNOFF (CFSM)	1.36
SEVEN-DAY LOW FLOW	2.41	TOTAL RUNOFF (INCHES)	6.30
INSTANTANEOUS PEAK FLOW	2455 (Sept. 6. 1990)		

NOTE: e = ESTIMATED

TAMAYARIAK RIVER, LOWER WEST FORK

LOCATION.--Lat 69°58.83′ N., long 145°47.67′ W., NW¼NW¼ sec 12, T.7N., R.25E., Umiat Meridian, 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--98.14 mi², of which 5.55 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; and June to Sept. 1991.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES.--Maximum Discharge, 2,455 cfs Sept 6, 1990 @ 2246 hrs; Minimum Discharge, 9.0 cfs August 6 & 7, 1988.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1160 e	92	42	40
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2050 e	66	40	36
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1210 e	51	38	34
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	840 e	42	36	35
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	630 e	39	33	39
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	590 e	35	30	32
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	537	38	29	28
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	341	40	29	29
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	265	34	28	26
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	205	34	28	29
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	142	30	29	33
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	144	28	27	39
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	288	27	24	25
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1187	24	23	28
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	811	24	25	30
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	441	25	23	26
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	312	26	22	30
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	485	26	22	51
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	576	51	21	56
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	537	94	20	50
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	467	341	19	141
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	310 e	341	929	24	145
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	340 e	219	960 e	48	97
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	380 e	183	400 e	241	66
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	400 e	140	163	193	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	410 e	142	92	120	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	440 e	135	71	83	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	500 e	135	66	70	---
29	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	610 e	138	56	70	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	720 e	151	49	63	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	---	890 e	---	46	48	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5560	14800	3997	1547	1144
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	371	493	129	50	48
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	890	2050	960	241	145
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20	135	24	19	25
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.78	5.03	1.31	0.51	0.49
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.11	5.61	1.51	0.59	0.43
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11028	29355	7928	3069	2268

TOTAL	27048		TOTAL RUNOFF (AC-FT)	53649
MEAN (MAY 17 TO SEP 24)	206		AVERAGE RUNOFF (CFSM)	2.10
SEVEN-DAY LOW FLOW	21.50		TOTAL RUNOFF (INCHES)	10.25
INSTANTANEOUS PEAK FLOW	1750	(July 23, 1991)		

NOTE: e = Estimated

Tamayariak River, Middle Fork

LOCATION.--Lat 69°58.55′ N., long 145°46.73′ W., in center sec 12, T.7N., R.25E., Umiat Meridian, 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--61.3 mi², of which 0.79 mi² are located within the Arctic National Wildlife Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 618 cfs Sept. 5, 1988 @ 0530 hrs; Minimum Discharge, 1.2 cfs Aug 6 & 7, 1988.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	40 e	2.4	64
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	30 e	2.4	55
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	20 e	2.8	88
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	20 e	2.0	127
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	10 e	1.5	445
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	10 e	1.4	164
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	10 e	1.7	89
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	10 e	159	58
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	9.0 e	351	45
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	8.0 e	135	39
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	7.0 e	84	34
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	320 e	7.0 e	127	31
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1060 e	6.0 e	196	29
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1300 e	6.0 e	118	31
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1200 e	5.0 e	77	24
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1130 e	5.0 e	77	21
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	980 e	5.0 e	79	17
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	830 e	7.9	72	12
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	700 e	7.9	75	9.4
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	570 e	6.7	75	17
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	480 e	5.2	159	15
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	400 e	4.3	218	7.9
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	320 e	4.0	193	5.6
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	240 e	4.0	179	7.3
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	190 e	3.6	97	7.9
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	140 e	3.1	72	5.6
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	110 e	3.1	82	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	170 e	90 e	2.6	66	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	210 e	70 e	2.4	82	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	210 e	50 e	2.2	199	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	170 e	---	2.8	100	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	910	11520	268	3089	1449
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	152	384	8.6	100	56
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	210	1300	40	351	445
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	50	2.2	1.4	5.6
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	6.26	0.14	1.63	0.91
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.55	6.99	0.16	1.87	0.88
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1805	22850	531	6126	2873

TOTAL	17235		TOTAL RUNOFF (AC-FT)	34185
MEAN (MAY 26 TO SEP 26)	139		AVERAGE RUNOFF (CFSM)	2.27
SEVEN-DAY LOW FLOW	2.02		TOTAL RUNOFF (INCHES)	10.46
INSTANTANEOUS PEAK FLOW	618	(Sept. 5, 1988)		

NOTE: e = ESTIMATED

Tamayariak River, Middle Fork

LOCATION.--Lat 69°58.55′ N., long 145°46.73′ W., in center sec 12, T.7N., R.25E., Umiat Meridian, 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--61.3 mi², of which 0.79 mi² are located within the Arctic National Wildlife Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 618 cfs Sept. 5, 1988 @ 0530 hrs; Minimum Discharge, 1.2 cfs Aug 6 & 7, 1988.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	680 e	20	242	124
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	810 e	19	255	85
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	950 e	20	212	98
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1090 e	29	162	81
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1220 e	36	108	60
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1730 e	36	77	51
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1780 e	34	70	62
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1320 e	21	70	57
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	800 e	18	60	49
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	670 e	23	52	48
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	490 e	27	160	143
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	350 e	19	152	162
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	270 e	18	116	171
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220 e	17	214	214
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	14	179	198
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	15	214	118
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	124	175	70
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	196	112	48
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	118	81	33
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	106	220	45
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	98	282	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	114	158	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	104	90	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	108	62	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	76	52	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	198	51	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40 e	255	48	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	40 e	141	43	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	34	77	48	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	26	48	51	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	39	112	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	13610	2168	3928	1917
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	454	70	127	96
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	1780	255	282	214
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	26	14	43	33
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	7.40	1.14	2.07	1.56
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	8.26	1.32	2.38	1.16
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	26995	4300	7791	3802

TOTAL	21623		TOTAL RUNOFF (AC-FT)	42889
MEAN (JUN 5 TO SWP 20)	193		AVERAGE RUNOFF (CFSM)	3.15
SEVEN-DAY LOW FLOW	18.87		TOTAL RUNOFF (INCHES)	13.12
INSTANTANEOUS PEAK FLOW	303	(Aug. 21, 1989)		

NOTE: e = ESTIMATED

Tamayariak River, Middle Fork

LOCATION.--Lat 69°58.55′ N., long 145°46.73′ W., in center sec 12, T.7N., R.25E., Umiat Meridian, 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--61.3 mi², of which 0.79 mi² are located within the Arctic National Wildlife Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 637 cfs Sept. 6, 1990 @ 1924 hrs; Minimum Discharge, 0.1 cfs Sept. 19, 1990 @ 2359.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	11	0.8	46
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	10	0.7	49
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	9.1	0.7	39
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	7.3	0.7	26
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	6.4	0.7	17
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	5.8	0.6	195
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	5.2	0.7	204
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	7.0	0.7	69
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	5.2	0.7	34
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	4.5	0.7	12
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	3.0 e	30 e	4.0	0.7	5.5
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	4.0 e	26	3.4	0.7	3.6
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	8.0 e	41	2.8	0.5	2.6
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	40	2.5	0.5	2.0
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	44	2.0	0.4	1.9
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	170 e	43	1.9	0.5	2.2
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2410 e	54	2.0	0.5	1.4
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1730 e	50	1.8	0.5	0.7
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	740 e	44	1.5	0.5	0.3
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	500 e	38	1.4	0.5	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	380 e	78	1.6	0.5	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	290 e	151	2.5	0.5	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	230 e	100	1.8	0.5	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	23	1.3	0.5	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	23	1.2	0.5	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	22	1.2	0.5	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	20	1.1	0.6	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	16	1.0	0.9	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	40 e	15	0.9	1.3	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	40 e	12	0.9	1.5	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	30 e	---	0.8	4.7	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7145	1170	108	24	711
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	340	39	3.5	0.78	37
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2410	151	11	4.7	204
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	12	0.82	0.41	0.30
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.55	0.64	0.06	0.01	0.61
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.33	0.71	0.07	0.01	0.43
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14172	2320	215	48	1410

TOTAL	9158		TOTAL RUNOFF (AC-FT)	18165
MEAN (MAY 11 TO SEP 19)	69		AVERAGE RUNOFF (CFSM)	1.13
SEVEN-DAY LOW FLOW	0.46		TOTAL RUNOFF (INCHES)	5.56
INSTANTANEOUS PEAK FLOW	637	(Sept. 6, 1990)		

NOTE: e = ESTIMATED

Tamayariak River, Middle Fork

LOCATION.--Lat 69°58.55′ N., long 145°46.73′ W., in center sec 12, T.7N., R.25E., Umiat Meridian, 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,867 cfs June 4, 1991 @ 0003 hrs; Minimum Discharge, 0.1 cfs Sept. 19, 1990 @ 2359.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	790 e	55	35	15
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1580 e	43	31	12
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1350 e	34	27	11
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1293	28	25	9.5
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	845	23	23	7.9
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	499	27	26	7.4
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	219	29	19	6.9
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120	22	18	7.9
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	86	20	15	6.5
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	55	18	13	6.1
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	38	16	10 e	6.4
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	66	15	9.5 e	6.9
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	808	16	9.5 e	6.4
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	817	14	9.5	5.7
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	426	21	9.9	5.5
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	252	29	8.8	5.8
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	5.0 e	226	33	8.5	11
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	9.0 e	326	28	7.6	76
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	230	26	7.4	121
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	249	33	7.2	126
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	192	181	6.9	108
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	160 e	116	599	11	92
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	74	800	111	61
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	75	264	225	45
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	210 e	66	121	134	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220 e	77	72	81	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	240 e	78	57	53	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	280 e	83	52	37	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	360 e	87	44	27	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	440 e	73	38	21	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	570 e	---	39	17	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3104	11198	2795	1048	766
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	207	373	90	34	32
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	570	1580	800	225	126
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	38	14	6.9	5.5
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.38	6.09	1.47	0.55	0.52
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.88	6.79	1.70	0.64	0.46
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6157	22212	5544	2078	1519

TOTAL	18910		TOTAL RUNOFF (AC-FT)	37507
MEAN (MAY 17 TO SEP 24)	144		AVERAGE RUNOFF (CFSM)	2.35
SEVEN-DAY LOW FLOW	6.11		TOTAL RUNOFF (INCHES)	11.47
INSTANTANEOUS PEAK FLOW	1867	(June 4, 1991)		

NOTE: e = ESTIMATED

Tamayariak River, Middle Fork

LOCATION.--Lat 69°58.55′ N., long 145°46.73′ W., in center sec 12, T.7N., R.25E., Umiat Meridian, 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--61.3 mi², of which 0.79 mi² are located within the Arctic National Wildlife Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991; and June to Sept. 1992.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,867 cfs June 4, 1991 @ 0003 hrs; Minimum Discharge, 0.1 cfs Sept. 19, 1990 @ 2359.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	470 e	17	1.2	70
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	220 e	13	1.0	58
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	103	9.5	0.8	50
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	54	8.2	0.8	43
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	42	8.8	0.6	38
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60	6.5	0.6	37
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	52	5.6	0.6	37
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	164	3.9	0.8	38
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	193	3.2	0.8	36
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	286	3.1	0.8	36
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	269	3.2	0.8	38
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	170	3.2	1.0	18
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	94	2.7	0.8	17
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	72	2.4	0.8	15
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	63	2.1	0.8	4.3
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	53	2.0	0.8	---
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	45	1.9	1.8	---
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	37	1.8	1.9	---
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	40	1.7	1.6	---
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	39	1.8	1.3	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	29	1.6	1.2	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	27	1.4	1.2	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	27	1.3	1.0	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	21	1.2	1.0	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	16	1.2	1.0	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	15	1.2	7.6	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	14	1.2	1026	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	14	1.0	467	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	740 e	13	1.0	244	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	1020 e	12	0.8	142	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	930 e	---	1.0	94	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2710	2712	114	2004	538
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	678	90	3.7	65	36
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1020	470	17	1026	70
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20	12	0.80	0.60	4.3
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.05	32.98	1.87	32.70	8.78
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.64	1.23	0.07	1.22	0.33
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5375	4010	227	3975	1068

TOTAL	8079		TOTAL RUNOFF (AC-FT)	16024
MEAN (MAY 28 TO SEP 15)	73		AVERAGE RUNOFF (CFSM)	1.19
SEVEN-DAY LOW FLOW	0.71		TOTAL RUNOFF (INCHES)	4.90
INSTANTANEOUS PEAK FLOW	1455	(Aug. 27, 1992)		

NOTE: e = ESTIMATED

TAMAYARIAK RIVER, UPPER WEST FORK

LOCATION.--Lat 69°49.97′ N., long 145°55.25′ W., in the center W½W½ sec 33, T.6N., R.25E., Umiat Meridian, 13.9 mi upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--49.2 mi², which 5.6 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the frist week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 404 cfs Aug 13, 1988 @ 0315 hrs; Minimum Discharge, 0.8 cfs July 29-31, 1988.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	50 e	1.2	49
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	40 e	1.1	40
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	30 e	1.2	51
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	20 e	1.1	72
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	20 e	1.1	240
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	20 e	1.2	129
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	14 e	1.5	72
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	12 e	88	47
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	11 e	240	35
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	10 e	106	29
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	9.0 e	60	22
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	360 e	8.0 e	168	15
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1220 e	7.0 e	271	11
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1490 e	7.0 e	110	8.2
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1380 e	6.0 e	60	7.3
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1300 e	5.0 e	54	6.9
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1120 e	4.0 e	48	6.2
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	960 e	3.1	43	5.8
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	800 e	2.3	41	5.2
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	650 e	1.6	42	4.9
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	550 e	1.2	143	4.9
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	450 e	1.0	217	4.4
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	360 e	0.92	189	3.7
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	280 e	1.1	178	5.5
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	210 e	1.0	94	8.2
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	160 e	0.92	64	4.9
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	120 e	130 e	0.92	65	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	190 e	100 e	0.92	54	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	230 e	80 e	0.87	70	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	190 e	60 e	0.82	143	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	160 e	---	1.0	78	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	940	13160	291	2636	890
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	157	439	9.4	85	34
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	230	1490	50	271	240
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50	60	0.8	1.1	3.7
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.18	8.92	0.19	1.73	0.70
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.71	9.95	0.22	1.99	0.67
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1864	26102	577	5228	1764

TOTAL	17916		TOTAL RUNOFF (AC-FT)	35536
MEAN (MAY 26 TO SEP 26)	144		AVERAGE RUNOFF (CFSM)	2.94
SEVEN-DAY LOW FLOW	0.92		TOTAL RUNOFF (INCHES)	13.54
INSTANTANEOUS PEAK FLOW	404	(Aug. 13, 1988)		

NOTE: e = ESTIMATED

TAMAYARIAK RIVER, UPPER WEST FORK

LOCATION.--Lat 69°49.97′ N., long 145°55.25′ W., in the center W½W½ sec 33, T.6N., R.25E., Umiat Meridian, 13.9 mi upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--49.2 mi^2, which 5.6 mi^2 are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data due to equipment electronic problems. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,478 cfs Aug 20, 1989 @ 1975 hrs; Minimum Discharge, 0 cfs July 9-10, and 13, 1989.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	60 e	17	130 e	48
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	14	170 e	42
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	80 e	15	130 e	44
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	360 e	25	90 e	41
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1400 e	21	70 e	37
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1990 e	21	60 e	37
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	2050 e	21	50 e	44
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1510 e	11	50 e	40
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	910 e	3.4	40 e	37
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	760 e	6.6	40 e	36
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	550 e	20	80 e	149
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	400 e	12	90 e	171
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	300 e	3.4	123	242
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	10 e	486	191
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	210 e	10 e	248	74
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	160 e	30 e	424	45
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	220 e	180	37
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	170 e	74	34
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	327	90 e	49	30
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	206	70 e	319	27
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	185	80 e	530	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	101	80 e	116	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	101	90 e	55	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	86	80 e	42	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	51	60 e	41	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	45	120 e	40	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	38	170 e	39	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	35	100 e	37	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	30	60 e	37	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	---	24	40 e	37	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	---	---	30 e	43	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	12529	1699	3920	1406
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	418	55	126	70
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	2050	220	530	242
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	24	3.4	37	27
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	8.49	1.11	2.57	1.43
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	9.47	1.28	2.96	1.06
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	24851	3371	7775	2789

TOTAL	19554		TOTAL RUNOFF (AC-FT)	38785
MEAN (JUN 1 TO SEP 20)	175		AVERAGE RUNOFF (CFSM)	3.55
SEVEN-DAY LOW FLOW	10.89		TOTAL RUNOFF (INCHES)	14.78
INSTANTANEOUS PEAK FLOW	1478	(Aug. 20, 1989)		

NOTE: e = ESTIMATED

TAMAYARIAK RIVER, UPPER WEST FORK

LOCATION.--Lat 69°49.97′ N., long 145°55.25′ W., in the center W½W½ sec 33, T.6N., R.25E., Umiat Meridian, 13.9 mi upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--49.2 mi², which 5.6 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,478 cfs Aug 20, 1989 @ 1975 hrs; Minimum Discharge, 0 cfs July 9-10, and 13, 1989, July 19-20 and Aug. 6-18, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	6.2	0.7	432
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	5.2	0.5	190
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	4.2	0.1	101
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	3.7	0.3	60
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	3.2	0.1	49
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	2.8	0.0	629
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	2.1	0.0	480
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	2.2	0.0	168
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	9.0 e	1.7	0.0	85
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	8.0 e	1.8	0.0	57
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	7.0 e	1.8	0.0	98
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	25	1.5	0.0	35
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	35	1.2	0.0	121
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	30	1.2	0.0	74
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	34	0.9	0.0	130
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	130	0.3	0.0	217
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	---	130	0.5	0.0	124
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1730 e	69	0.3	0.0	452
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	740 e	40	0.0	2.0	509
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	500 e	27	0.0	2.6	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	380 e	18	0.9	2.6	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	290 e	15	2.6	2.3	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	230 e	11	2.3	2.1	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	8.7	2.5	1.8	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	8.7	2.2	1.7	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	90 e	7.6	2.0	1.5	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	70 e	6.2	1.4	2.6	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50 e	6.0	1.4	3.5	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	40 e	7.2	1.4	49	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	40 e	6.7	1.2	145	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	30 e	---	0.9	323	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4500	769	60	541	4010
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	321	26	1.9	17	211
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1730	130	6.2	323	629
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30	6.0	0.00	0.00	35
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.53	0.52	0.04	0.35	4.29
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.40	0.58	0.05	0.41	3.03
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8926	1525	118	1073	7954

TOTAL	9880		TOTAL RUNOFF (AC-FT)	19597
MEAN (MAY 18 TO SEP 19)	79		AVERAGE RUNOFF (CFSM)	1.61
SEVEN-DAY LOW FLOW	0.00		TOTAL RUNOFF (INCHES)	7.47
INSTANTANEOUS PEAK FLOW	1328	(Sept. 6, 1990)		

NOTE: e = ESTIMATED

TAMAYARIAK RIVER, UPPER WEST FORK

LOCATION.--Lat 69°49.97′ N., long 145°55.25′ W., in the center W½W½ sec 33, T.6N., R.25E., Umiat Meridian, 13.9 mi upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--49.2 mi², which 5.6 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,478 cfs Aug 20, 1989 @ 1975 hrs; Minimum Discharge, 0 cfs July 9-10, and 13, 1989, July 19-20 and Aug. 6-18, 1990.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	900 e	57	33	27
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	1820 e	46	29	19
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	950 e	38	24	14
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	610 e	32	21	11
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	410 e	30	20 e	9.4
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	270 e	38	16	7.1
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	36	14	4.6
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	410 e	24	12	4.4
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	110 e	17	15	4.1
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	130 e	13	13	2.7
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	210 e	9.1	9.9	3.6
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	330 e	13	8.0	2.6
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	390 e	17	6.7	2.3
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	340 e	21	6.7	3.1
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	320 e	34	8.9	2.3
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	590 e	39	15	2.3
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	5.0 e	420 e	35	16	3.3
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10 e	180 e	44	13	27
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	20 e	210 e	63	10	130
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	100 e	350	71	7.5	137
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	140 e	302	373	6.3	134
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	180 e	203	654	18	109
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	200 e	151	681	202	68
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	230 e	116	240	186	51
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	240 e	96	117	111	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	250 e	100	74	72	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	280 e	98	63	57	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	320 e	98	60	65	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	410 e	102	49	68	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	500 e	82	42	52	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	650 e	---	41	38	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3535	10497	3071	1171	779
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	236	350	99	38	32
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	650	1820	681	202	137
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	82	9.1	6.3	2.3
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.79	7.11	2.01	0.77	0.66
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.67	7.93	2.32	0.89	0.59
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7012	20821	6091	2323	1545

TOTAL	19055		TOTAL RUNOFF (AC-FT)	37794
MEAN (MAY 17 TO SEP 24)	145		AVERAGE RUNOFF (CFSM)	2.96
SEVEN-DAY LOW FLOW	2.70		TOTAL RUNOFF (INCHES)	14.40
INSTANTANEOUS PEAK FLOW	1219	(July 22, 1991)		

NOTE: e = ESTIMATED

TAMAYARIAK RIVER, UPPER WEST FORK

LOCATION.--Lat 69°49.97′ N., long 145°55.25′ W., in the center W½W½ sec 33, T.6N., R.25E., Umiat Meridian, 13.9 mi upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--49.2 mi², which 5.6 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991; and June to Sept. 1992.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Missing data due to bear damage (7/3/92 to 8/7/92), and a flood on Aug 6, 1992 which caused significant channel scour. Stream discharge gaging was discontinued. River normally freezes to substrate the first week of October.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,478 cfs Aug 20, 1989 @ 1975 hrs; Minimum Discharge, 0 cfs July 9-10, and 13, 1989, July 19-20 and Aug. 6-18, 1990, and Aug 8-17, 1992.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	890 e	8.2	4.0 e	---
2	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	500 e	4.9	3.0 e	---
3	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	264	4.1	3.0 e	---
4	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	101	8.0 e	2.0 e	---
5	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	82	10 e	2.0 e	---
6	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	148	10 e	1.0 e	---
7	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	121	8.0 e	1.0 e	---
8	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	293	7.0 e	0.0	---
9	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	327	6.0 e	0.0	---
10	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	425	7.0 e	0.0	---
11	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	401	6.0 e	0.0	---
12	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	286	30 e	0.0	---
13	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	161	20 e	0.0	---
14	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	123	10 e	0.0	---
15	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	99	10 e	0.0	---
16	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	83	10 e	0.0	---
17	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	65	7.0 e	0.5	---
18	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	50	5.0 e	0.3	---
19	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	44	5.0 e	0.3	---
20	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	35	30 e	0.3	---
21	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	24	40 e	0.3	---
22	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	22	20 e	0.3	---
23	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	18	10 e	0.3	---
24	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	12	10 e	0.4	---
25	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	9.0	9.0 e	0.4	---
26	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	9.9	8.0 e	---	---
27	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	10	8.0 e	---	---
28	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	0.0 e	30 e	9.0	7.0 e	---	---
29	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	850 e	7.8	6.0 e	---	---
30	0.0 e	0.0 e	0.0 e	0.0 e	---	0.0 e	0.0 e	1170 e	6.6	5.0 e	---	---
31	0.0 e	---	0.0 e	0.0 e	---	0.0 e	0.0 e	1060 e	---	4.0 e	---	---
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3110	4625	333	19.1	---
MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	778	154	11	0.73	---
MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1170	890	40	4.0	---
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30	6.6	4.0	0.00	---
CFSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.80	3.13	0.22	0.01	---
IN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.35	3.50	0.25	0.01	---
AC-FT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6169	9174	661	38	---

TOTAL	8088		TOTAL RUNOFF (AC-FT)	16042
MEAN (MAY 28 TO AUG 25)	89		AVERAGE RUNOFF (CFSM)	1.81
SEVEN-DAY LOW FLOW	0.00		TOTAL RUNOFF (INCHES)	6.11
INSTANTANEOUS PEAK FLOW	996	(June 10. 1992)		

NOTE: e = ESTIMATED

WATER RESOURCE INVENTORY AND ASSESSMENT, ARCTIC NATIONAL WILDLIFE REFUGE

Progress Report

April 1989

Region 7
U.S. Fish and Wildlife Service
Department of the Interior

PROGRESS REPORT

WATER RESOURCE INVENTORY AND ASSESSMENT
ARCTIC NATIONAL WILDLIFE REFUGE

1988 Stream Discharge Gaging Data

Steven M. Lyons

Fisheries Management Services
Water Resource Branch
Fish and Wildlife Service
U.S. Department of the Interior
Anchorage, Alaska

April 1989

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PROGRESS REPORT

WATER RESOURCE INVENTORY AND ASSESSMENT
ARCTIC NATIONAL WILDLIFE REFUGE

1988 Stream Discharge Gaging Data

Introduction

This progress report is intended to provide an accounting of the accomplishments made during the first year of a multi-year water resource inventory in the 1002 area of the Arctic National Wildlife Refuge. It is also intended to extend the available stream discharge and water temperature data to resource specialists for consideration in other inventory or management activities. This data represents the hydrologic conditions for only one point in time. Thus, it is premature to attempt any hydrologic analysis or comparisons. Additional years of data collection are required before any characterization of the hydrologic regime is appropriate.

The 1002 area of the Arctic National Wildlife Refuge is located in a remote area of Alaska adjacent to the Beaufort Sea. Because of its remoteness, logistical problems, small populace of the area, harsh climatic characteristics, and lack of competitive water uses in the past, there has been little interest by either state or federal agencies to measure the water yield and flood frequencies in the 1002 area (Appendix A). The nearest stream gaging station (US Geological Survey gage #15908000, Sagavanirktok River) is located 80 miles west of the Canning River. Because the Sagavanirktok River is larger than any river within the 1002 area, the data base for this river can not be extrapolated to streams and rivers in the 1002 area for water availability and flood characteristics.

Childers, et al. (1977) reported the only hydrologic data for the 1002 area. The data reported was a reconnaissance level investigation of the rivers, springs, aufeis fields, and lakes of the north slope, including the 1002 area. The data reported by Childers includes channel characteristics, watershed basin characteristics and estimated flood characteristics of the Canning River, Marsh Creek, Sadlerochit River, Hulahula River, Jago River, and Okerokovik River. Childers also reported discharge rates and selected water quality parameters for the Katakturuk River Spring, Sadlerochit Spring, Hulahula River Spring, and Okerokovik River Spring. Six lakes were sampled for water quality and some data for ice thickness and total lake depth were reported.

With the potential for oil and gas exploration and development in the 1002 area of the Arctic National Wildlife Refuge, an inventory and assessment of water resources is needed for refuge streams. The objectives of this years activities was to initiate a program to quantify the water yield and seasonal stream discharge of the watersheds making up the 1002 area of the Arctic National Wildlife Refuge. A secondary objective was to measure surface water temperatures at stream discharge gaging sites.

Methods

The Water Resources Branch initiated a stream gaging network, consisting of 8 stream gaging stations in the 1002 area in 1988 (Figure 1). Stream discharge data was collected at four sites on the Tamayariak River and one site each on the Akutoktak River, Itkilyariak Creek, Sadlerochit River, and Sadlerochit Spring Creek. Because the Tamayariak River is hydrologically diverse and has abundant fish and wildlife resources, four stream gages were installed on this watershed.

The parameters measured at each gaging site were water depth and water temperature, except for the Akutoktak River where only water depth was measured. Water depth and water temperature were measured at 15 minute intervals utilizing submerged pressure and temperature probes attached to a computerized field recorder. Water depth was measured to the nearest 0.01 foot and temperature to the nearest 0.1 degree centigrade. The field recorder summarizes this data automatically at the end of each 24 hour period into a report and provides the 24 hour average depth, maximum depth, time of maximum depth, minimum depth, time of minimum depth, 24 hour average temperature, maximum temperature, time of maximum temperature, minimum temperature, and time of minimum temperature. This report is stored in a computer chip which can later be down loaded onto a computer.

Throughout the data collection period, biweekly visits to each site were made to collect calibration data. Calibration data included stream discharge and water surface elevation. Through a log-log correlation analysis of stream depth (x) and stream discharge (y), correlation equations were obtained for each stream gage. More than one equation usually exists for each gaging site. As water depth changes the hydraulic radius changes, and a different equation is required to represent the relationship between water depth and stream discharge. Using the correlation equations developed, water depth data recorded by the stream gages was converted to stream discharge. The calibration data were collected using standard stream discharge measurement procedures (Buchanan and Somers 1969, Lyons 1988).

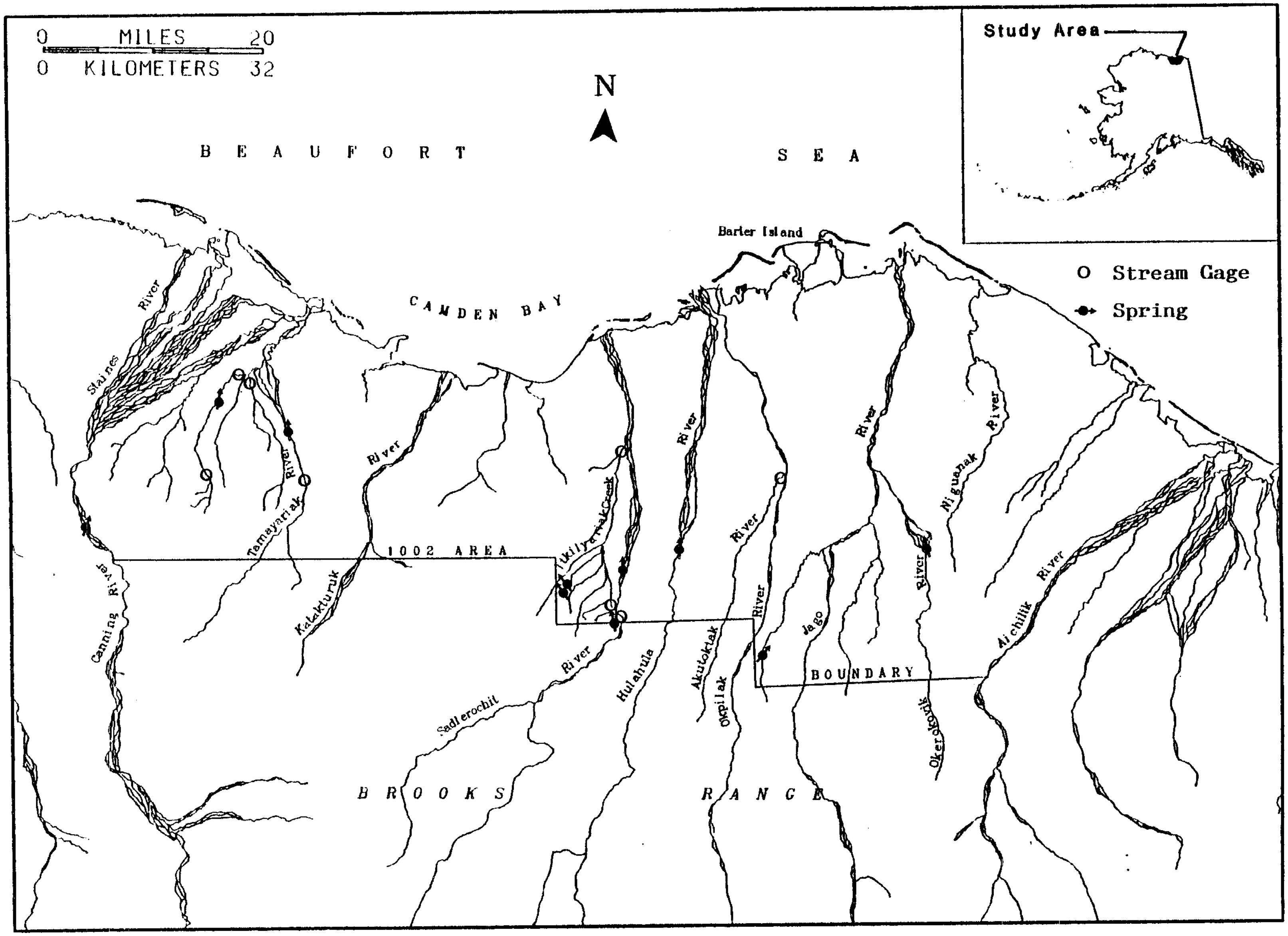

Figure 1.--The 1002 area of the Arctic National Wildlife Refuge with stream gage locations and known springs.

Results

All stream gaging stations were operating by July 20, 1988 and were in service until September 27 or 28, 1988. The only exception is the Sadlerochit Spring Creek gage, which was left to operate throughout the winter. A problem with a loose connector on the Sadlerochit River stream gage resulted in the loss of data from July 28, 1988 through August 15, 1988. A similar problem occurred at the Tamayariak River gage in August. It appeared that an animal pulled or tripped over the cable that connects the probe with the recorder. This resulted in the loss of the temperature data for August 11 and 12, 1988.

For the seven streams where depth data was retrieved, stream discharge was highly correlated with water depth (Table 1). Correlation coefficients (r^2) ranged from 0.966 to 0.999.

Appendix B displays the stream discharges obtained for the 1988 field season, except for Sadlerochit Spring Creek. The daily average discharge, time of maximum discharge, maximum discharge, time of minimum discharge, and minimum discharge for each day is listed for each gage. Also listed is the monthly average discharge, monthly maximum discharge, and monthly minimum discharge.

Appendix C lists the temperature data for each site except Sadlerochit Spring Creek and Akutoktak River. This data includes daily average temperature, time of maximum temperature, maximum discharge, time of minimum temperature, and minimum temperature.

Discussion

Fiscal Year 1988 was the first year of a multi-year water resource inventory program designed to quantify stream discharge rates, discharge frequency distribution, average monthly water yields, and flood frequencies and sizes within the 1002 area of the Arctic National Wildlife Refuge. During spring breakup some problems were encountered in the placement of the water pressure probe used to measure water depth. Concrete anchors were designed to allow for the placement of the pressure probes during the high spring breakup flows of future years.

The stream gaging station which was planned for the Canning River was not installed because the collection of the calibration data from an inflatable boat was not considered to be safe. The installation of a stream gage in the Canning River will require a permanent cableway with cable car.

Table 1.--Stream gage locations and correlation equations for converting stream depth (X) to stream discharge (Y).

Watershed	Gage Location	Correlation Equation	r^2
Akutoktak River	Center sec. 36, T.6N., R.33E.	$y=0.791e^{2.418x}$	0.993
Itkilyariak Creek	SE1/4NW1/4 sec. 15, T.6N., R.31E.	$y=0.965e^{1.783x}$	0.999
Sadlerochit River	NW1/4SW1/4 sec. 31, T.4N., R.32E.	$(x \geq 2.2ft)$; $y=43.25e^{1.04x}$ $(x<2.2ft)$; $y=10.32e^{1.66x}$	0.998 0.993
Sadlerochit Spring Creek	NE1/4NW1/4 sec. 36, T.4N., R.31E.	data not given, still operating	
Tamayariak River	SW1/4NE1/4 sec. 35, T.6N., R.26E.	$(x>1.05ft)$; $y=27.25e^{1.26x}$ $(x \leq 1.05ft)$; $y=0.090e^{6.68x}$	0.982 0.974
Tamayariak River, Lower West Fork	NW1/4NW1/4 sec. 12, T.7N., R.25E.	$(x>1.93ft)$; $y=5.94e^{1.46x}$ $(x \leq 1.93ft)$; $y=0.90e^{2.44x}$	0.998 0.985
Tamayariak River, Middle Fork	Center sec. 12, T.7N., R.25E.	$(x>2.81ft)$; $y=0.39e^{1.49x}$ $(x \leq 2.81ft)$; $y=0.0000000007e^{8.638x}$	0.999 0.996
Tamayariak River, Upper West Fork	W1/2W1/2 sec. 33, T.6N., R.25E.	$(x \geq 1.76ft)$; $y=0.82e^{2x}$ $(x<1.76ft)$; $y=0.001e^{5.76x}$	0.995 0.966

The purpose of the stream gage on the Itkilyariak Creek was to quantify the discharge from the melting aufeis field located in the lower Sadlerochit Spring Creek. However, a suitable gaging site could not be located immediately below the aufeis field. The gaging site used in 1988 is too far downstream to meet the purpose of the gaging effort. This gage will not be installed in 1989 and the equipment moved to an unnamed tributary 2.4 miles upstream from the Itkilyariak Creek gaging site. The new proposed gaging site is located in the NW1/4SE1/4 sec. 28, T.6N., R.31E.

Statistical or hydrologic analysis of this data can not be conducted until a minimum of five years of data is contained in the data base. The past year (1988) was a good example of why a five year data base is necessary to develop a hydrologic description of the 1002 area. The climate from January through July 1988 was significantly drier and slightly warmer than the previous 38 years of record for Barter Island (University of Alaska-Fairbanks 1986, National Oceanic and Atmospheric Administration 1988). Precipitation during this period of time was 57 percent below normal. August 1988 was a very wet month compared to the 38 year average, with precipitation 66 percent above normal. September was again below normal, receiving only 55 percent of the long term average. From January 1988 through September 1988, precipitation was 76 percent below normal. However, if these watersheds are primarily groundwater fed systems, the local climatic conditions may not have a significant effect on the annual water yield. Several years of data are necessary to make such determinations.

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APPENDIX A

Glossary of Hydrologic Terms

Glossary of Hydrologic Terms

Aufeis: An ice feature that is formed by water overflowing onto a surface, such as river ice or gravel deposits, and freezing, with subsequent layers created by water overflowing onto the ice surface itself and freezing.

Discharge rate: The rate of flow, or volume of water flowing in a given stream at a given place and within a given period of time, expressed as cubic feet per second.

Discharge regime: The discharge pattern over a period of time.

Flood frequency: The probable frequency of recurrence of a flood event, expressed as the 10-year flood, 25-year flood, 100-year flood, etc.

Flood magnitude: The peak discharge of specified flood frequency.

Hydraulic radius: The ratio of the water cross-sectional area to the wetted perimeter.

Water yield: The total outflow of water from a watershed, expressed in units of acre-feet or gallons.

APPENDIX B

Surface water discharge records

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

Location: Lat 60° 49'58", long 143° 46'50", in center sec. 36, T.6N., R.33E., 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

Drainage Area: 97.1 mi^2, of which 66.0 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

Extremes: Maximum Discharge, 118.9 cfs Aug. 23, 1988; Minimum Discharge, 4.7 cfs Sept. 25, 1988.

JULY 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
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14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	8	615	8.7	45	7.4
21	8	900	8.7	2215	7.4
22	8	900	8.3	2230	7.0
23	8	845	8.5	0	7.2
24	8	845	8.9	0	7.8
25	8	545	9.2	2045	7.4
26	8	600	8.5	2315	6.6
27	7	515	7.8	2230	6.5
28	7	545	7.4	2245	6.1
29	6	545	7.0	2245	5.8
30	6	615	6.6	1830	5.6
31	6	815	7.0	2230	5.6
TOTAL	88				
AVERAGE	7		8.1		6.7
MAXIMUM	8		9.2		7.8
MINIMUM	6		6.6		5.6
ACRE FT	174				

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

AUGUST 1988

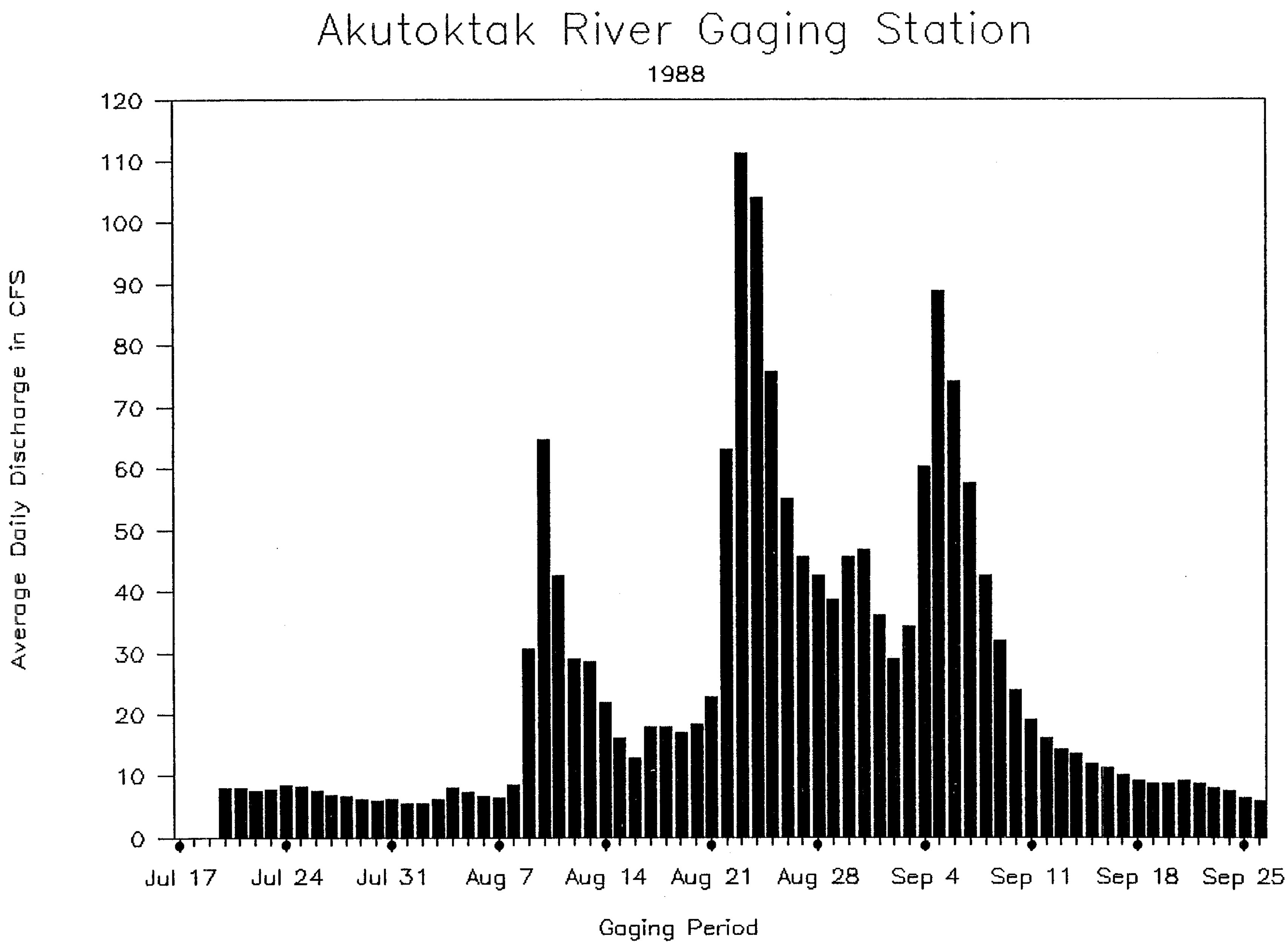
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	6	715	6.3	2215	5.2
2	5	715	5.9	2045	5.0
3	6	2315	7.8	400	5.0
4	8	700	8.9	2200	7.0
5	7	615	8.3	2130	6.6
6	7	615	7.6	2145	6.3
7	6	645	7.2	2000	5.8
8	8	2345	9.4	0	7.0
9	31	1500	66.1	0	9.4
10	65	945	72.4	2330	55.0
11	43	0	55.0	2345	32.0
12	29	800	32.0	1545	25.8
13	28	915	32.8	2200	24.0
14	22	730	25.2	2345	17.9
15	16	700	17.9	2345	14.3
16	13	715	14.3	2130	11.6
17	18	1115	20.2	0	12.5
18	18	1015	19.7	2015	16.2
19	17	1130	17.9	2100	15.8
20	18	830	20.2	0	16.6
21	23	2345	44.6	0	17.9
22	63	2345	92.9	0	44.6
23	111	830	118.9	0	95.1
24	104	830	111.2	2345	88.8
25	76	0	88.8	2345	63.1
26	55	0	63.1	2345	46.7
27	46	1430	47.8	2345	43.6
28	43	915	43.6	2345	39.7
29	39	945	39.7	1715	37.8
30	46	1330	52.5	0	38.7
31	47	1115	50.1	2330	40.6
TOTAL	1,023				
AVERAGE	33		39.0		27.6
MAXIMUM	111		118.9		95.1
MINIMUM	5		5.9		5.0
ACRE FT	2,029				

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

September 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	36	0	40.6	2330	29.8
2	29	1030	32.0	2345	23.4
3	34	1245	43.6	45	23.4
4	60	2345	74.1	0	37.8
5	89	930	95.1	0	74.1
6	74	30	81.1	2345	66.1
7	58	0	64.6	2330	49.0
8	43	0	49.0	2345	36.1
9	32	0	36.1	2345	27.1
10	24	0	26.4	2345	21.2
11	19	0	21.2	2330	17.4
12	16	0	17.4	2345	15.0
13	14	945	15.0	2345	13.5
14	14	1030	16.2	2345	11.3
15	12	1500	13.5	615	11.0
16	11	1545	11.9	645	10.7
17	10	0	11.0	1945	9.7
18	9	1200	9.7	1745	8.7
19	9	945	9.2	2145	8.3
20	9	1145	9.2	15	8.3
21	9	1300	9.9	2045	8.7
22	9	1000	9.9	1915	8.3
23	8	1230	8.9	1845	7.6
24	8	800	11.6	430	5.3
25	6	1115	10.2	645	4.7
26	6	1230	8.9	600	4.9
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
31	- - -	- - -	- - -	- - -	- - -
TOTAL	648				
AVERAGE	25		28.3		20.8
MAXIMUM	89		95.1		74.1
MINIMUM	6		8.9		4.7
ACRE FT	1,286				


Akutoktak River Gaging Station
1988
Average Daily Discharge in CFS
0
10
20
30
40
50
60
70
80
90
100
110
120
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Gaging Period

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek

Location: Lat 69° 52'35", long 144° 22', in SE1/4NW1/4 sec. 15, T.6N., R.31E., 6 miles upstream from the confluence with the Sadlerochit River, 24 miles southwest of Kaktovik, Alaska.

Drainage Area: 120.4 mi^2, of which 39 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

Extremes: Maximum Discharge, 422.1 cfs Sept. 5, 1988; Minimum Discharge, 50.6 cfs Sept. 25, 1988.

JULY 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	79	0	103.2	1245	68.5
21	66	15	80.4	2030	59.4
22	60	2345	74.8	1745	57.3
23	72	2215	92.7	1600	59.4
24	70	0	91.1	1815	63.8
25	74	2300	89.5	1415	63.8
26	71	2345	105.0	1515	59.4
27	78	100	108.8	1500	61.5
28	71	15	86.3	1430	60.4
29	65	0	83.3	1715	56.3
30	68	2130	58.3	1315	58.3
31	83	2300	114.8	945	68.5
TOTAL	857				
AVERAGE	71		90.7		61.4
MAXIMUM	83		114.8		68.5
MINIMUM	60		58.3		56.3
ACRE FT	1,700				

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek

AUGUST 1988

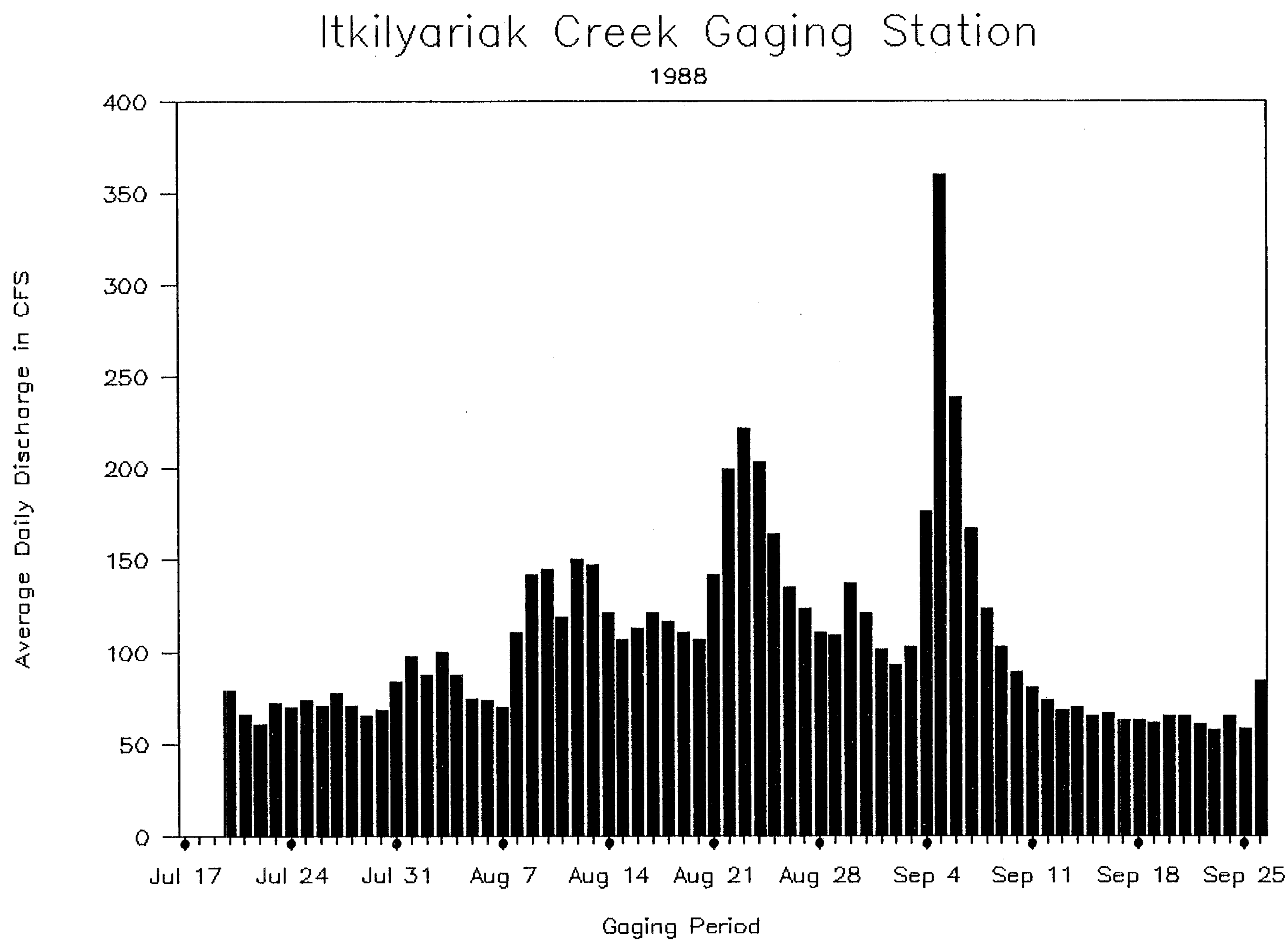
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	98	0	112.8	945	81.8
2	88	0	94.4	900	79.0
3	100	1330	116.9	115	87.9
4	88	45	97.8	1145	83.3
5	75	0	87.9	1545	67.3
6	74	30	87.9	1430	67.3
7	70	2345	83.3	1630	66.1
8	111	2300	134.8	0	84.8
9	142	2345	150.0	300	134.8
10	145	115	155.5	1830	132.4
11	119	15	142.2	830	110.8
12	150	1930	182.6	45	123.3
13	147	0	170.0	1630	134.8
14	121	15	137.2	1545	110.8
15	107	0	130.1	1430	97.8
16	113	2245	125.5	645	103.2
17	121	2215	137.2	1300	110.8
18	117	445	134.8	1915	108.8
19	111	2330	119.0	1615	106.9
20	107	30	119.0	1745	101.4
21	142	2315	196.1	415	106.9
22	200	2330	226.1	800	182.6
23	222	800	226.1	1715	214.3
24	203	100	218.2	2330	182.6
25	164	0	182.6	2330	150.0
26	135	0	152.7	1415	127.8
27	123	0	132.4	1730	119.0
28	111	115	123.3	2015	105.0
29	109	2330	127.8	1315	103.2
30	137	1745	142.2	0	127.8
31	121	0	134.8	2330	112.8
TOTAL	3,869				
AVERAGE	125		141.3		113.7
MAXIMUM	222		226.1		214.3
MINIMUM	70		83.3		66.1
ACRE FT	7,675				

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek

September 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	101	0	3.2	1300	91.1
2	93	2330	103.2	1000	79.0
3	103	2345	123.3	1300	94.4
4	176	2345	328.8	0	123.3
5	360	500	422.1	2345	295.5
6	239	0	295.5	2345	196.1
7	167	0	196.1	2245	142.2
8	123	0	142.2	1000	106.9
9	103	0	116.9	1430	94.4
10	89	15	97.8	1300	81.8
11	80	15	87.9	1500	76.2
12	74	0	77.6	1545	72.2
13	68	0	72.2	1215	61.5
14	70	700	84.8	930	56.3
15	65	0	71.0	1545	60.4
16	67	500	71.0	1730	64.9
17	63	2030	66.1	745	59.4
18	63	15	64.9	1615	60.4
19	62	500	62.6	1915	60.4
20	65	2215	68.5	30	62.6
21	65	15	68.5	1115	62.6
22	60	0	67.3	1045	58.3
23	57	0	60.4	1130	55.3
24	65	715	79.0	1115	52.4
25	58	2345	83.3	545	50.6
26	85	615	105.0	1900	61.5
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
31	- - -	- - -	- - -	- - -	- - -
TOTAL	2,621				
AVERAGE	101		116.1		87.7
MAXIMUM	360		422.1		295.5
MINIMUM	57		3.2		50.6
ACRE FT	5,199				


Itkilyariak Creek Gaging Station
1988
Average Daily Discharge in CFS
400
350
300
250
200
150
100
50
0
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Gaging Period

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

Location: Lat 69° 38', long 144° 22'50", in NW1/4SW1/4 sec. 31, T.4N., R.32E., 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

Drainage Area: 520.1 mi^2, of which 517.5 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi^2 depending on existing climatic conditions.

Remarks: This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

Extremes: Maximum Discharge, 2193.9 cfs Aug. 22, 1988; Minimum Discharge, 70.2 cfs Sept. 27, 1988.

JULY 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	846	0	938.2	2315	754.7
22	702	0	754.7	2330	652.8
23	607	0	652.8	2345	558.9
24	520	0	558.9	2345	483.4
25	454	30	483.4	2345	431.3
26	385	0	431.3	2045	366.0
27	342	0	372.2	2345	315.0
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
31	- - -	- - -	- - -	- - -	- - -
TOTAL	3,856				
AVERAGE	551		598.8		508.9
MAXIMUM	846		938.2		754.7
MINIMUM	342		372.2		315.0
ACRE FT	7,649				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

AUGUST 1988

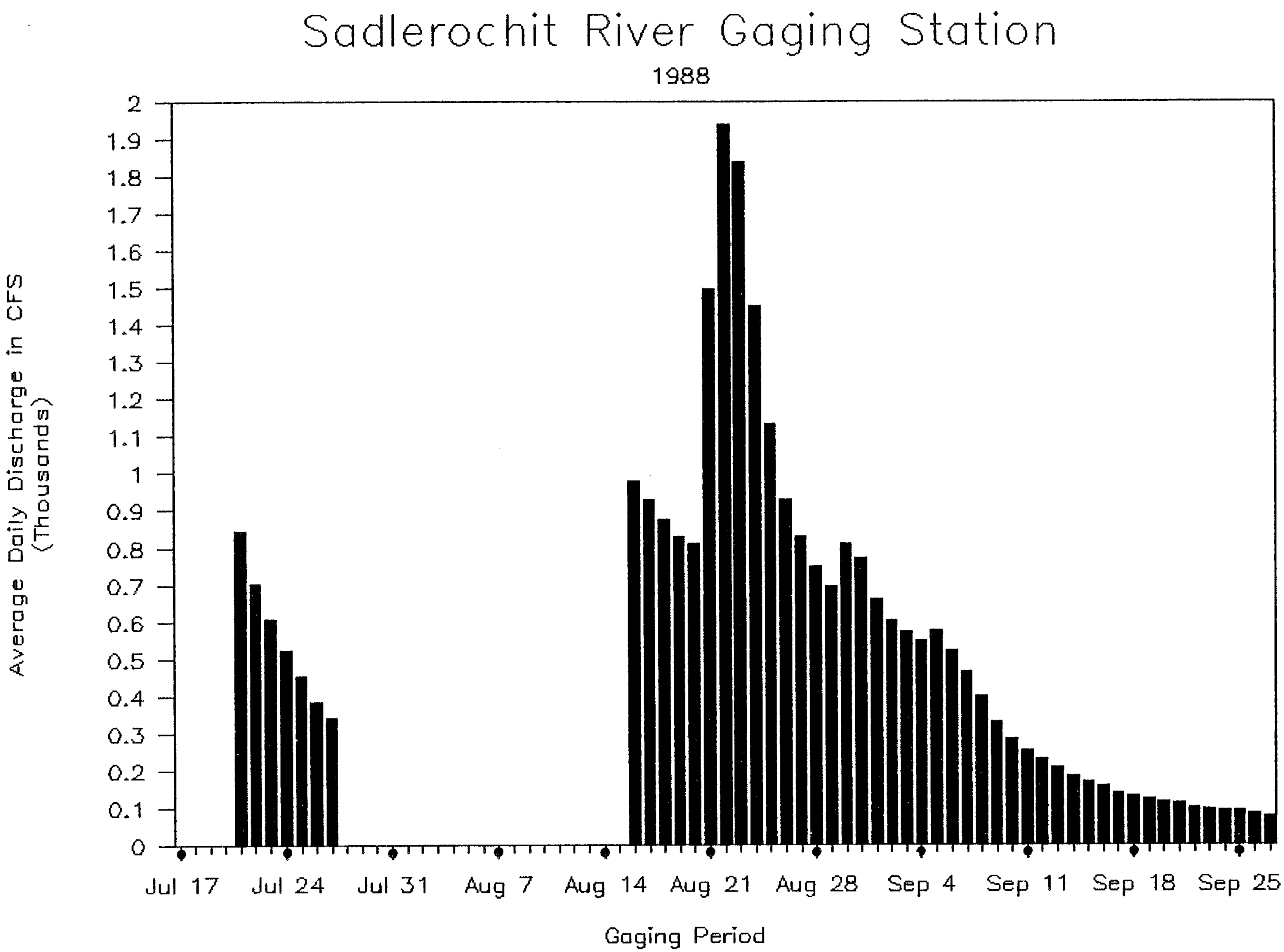
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	978	1500	1,084.6	0	794.9
17	928	0	998.3	2300	872.5
18	873	400	918.9	2300	828.5
19	828	600	854.6	2330	803.1
20	811	1430	828.5	2015	794.9
21	1,495	2130	1,897.7	30	819.9
22	1,937	1900	2,193.9	830	1,764.9
23	1,840	45	2,126.8	2345	1,641.5
24	1,450	45	1,658.6	2315	1,280.1
25	1,130	0	1,280.1	2345	1,008.7
26	928	0	1,008.7	2315	863.5
27	828	0	872.5	2215	778.6
28	747	0	778.6	2330	701.9
29	695	2330	739.3	1430	680.5
30	811	1615	828.5	0	739.3
31	771	30	828.5	2230	716.6
TOTAL	17,052				
AVERAGE	1,066		1,181.1		943.1
MAXIMUM	1,937		2,193.9		1,764.9
MINIMUM	695		739.3		680.5
ACRE FT	33,822				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

September 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	660	0	716.6	1745	632.9
2	601	15	639.4	1045	576.5
3	571	15	600.9	2315	553.1
4	547	2330	582.5	1215	530.7
5	577	400	594.7	2245	547.4
6	520	100	547.4	2345	483.4
7	464	15	488.5	2315	440.4
8	398	0	440.4	2345	360.0
9	331	100	360.0	2345	309.8
10	285	0	309.8	2345	266.6
11	254	300	271.1	2345	237.2
12	229	630	237.2	2345	218.3
13	208	15	218.3	2345	197.5
14	185	0	197.5	1100	178.7
15	170	15	181.7	1515	161.7
16	159	945	167.1	2345	148.7
17	139	100	151.2	1745	130.1
18	132	15	139.1	2345	128.0
19	122	0	125.9	2330	117.8
20	116	0	117.8	2330	113.9
21	110	245	113.9	1545	106.5
22	101	0	110.2	1430	96.4
23	95	0	103.0	1600	90.2
24	92	915	104.8	2100	80.2
25	92	1415	108.3	2345	84.4
26	84	745	91.7	2200	71.4
27	76	2200	87.2	1145	70.2
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	7,316				
AVERAGE	271		289.1		256.7
MAXIMUM	660		716.6		632.9
MINIMUM	76		87.2		70.2
ACRE FT	14,512				


Sadlerochit River Gaging Station
1988
Average Daily Discharge in CFS
(Thousands)
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Gaging Period

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

Location: Lat 69° 49'58", long 145° 33'10", in SW1/4NE1/4 sec. 35, T.6N., R.26E., 11.8 miles upstream from the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 136.1 mi2, of which 56.8 mi2 is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

Extremes: Maximum Discharge, 1,996 cfs Aug. 12, 1988; Minimum Discharge, 11.8 cfs Sept. 26,1988.

JULY 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	72	2345	134.2	230	51.3
18	124	30	135.9	2330	111.2
19	103	0	111.2	2315	71.7
20	59	0	71.7	2315	48.0
21	39	30	48.0	2345	34.4
22	30	15	34.4	2245	28.1
23	26	215	28.1	2345	24.6
24	25	815	26.3	130	24.6
25	25	1445	26.3	1145	23.0
26	23	2215	24.6	1400	21.5
27	22	0	24.6	2345	20.1
28	20	1415	20.1	1400	18.8
29	18	15	20.1	515	16.5
30	18	2300	18.8	900	16.5
31	23	2345	111.2	630	16.5
TOTAL	626				
AVERAGE	42		55.7		35.1
MAXIMUM	124		135.9		111.2
MINIMUM	18		18.8		16.5
ACRE FT	1241				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

AUGUST 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	508	2000	1163.4	0	114.0
2	508	45	1000.6	2345	267.7
3	459	1245	951.6	745	230.3
4	307	0	514.4	2315	213.6
5	177	0	213.6	2330	154.1
6	136	0	152.2	2345	122.9
7	120	2345	134.2	1530	112.6
8	225	2330	405.2	0	135.9
9	410	530	459.4	2345	344.2
10	289	115	348.5	2315	230.3
11	175	115	230.3	930	142.9
12	583	1445	1996.1	700	142.9
13	1039	100	1738.6	2330	590.6
14	395	0	583.2	2330	281.5
15	236	0	285.1	2215	210.9
16	201	30	213.6	2330	190.8
17	184	115	195.6	2315	174.7
18	173	330	176.9	2215	166.2
19	166	1645	168.3	2345	162.0
20	162	1645	168.3	745	156.0
21	307	2000	583.2	245	160.0
22	431	0	527.5	1230	390.2
23	416	2315	483.1	1230	380.5
24	416	100	501.6	2315	323.2
25	271	15	323.2	2300	227.4
26	219	0	233.2	1145	208.3
27	219	230	230.3	2345	198.1
28	186	100	203.1	2315	174.7
29	201	2345	327.3	730	170.4
30	336	630	385.4	2345	285.1
31	233	0	281.5	2330	200.6
TOTAL	9687				
AVERAGE	312		489.6		221.4
MAXIMUM	1039		1996.1		590.6
MINIMUM	120		134.2		112.6
ACRE FT	19214				

ARCTIC NATIONAL WILDLIFE REFUGE

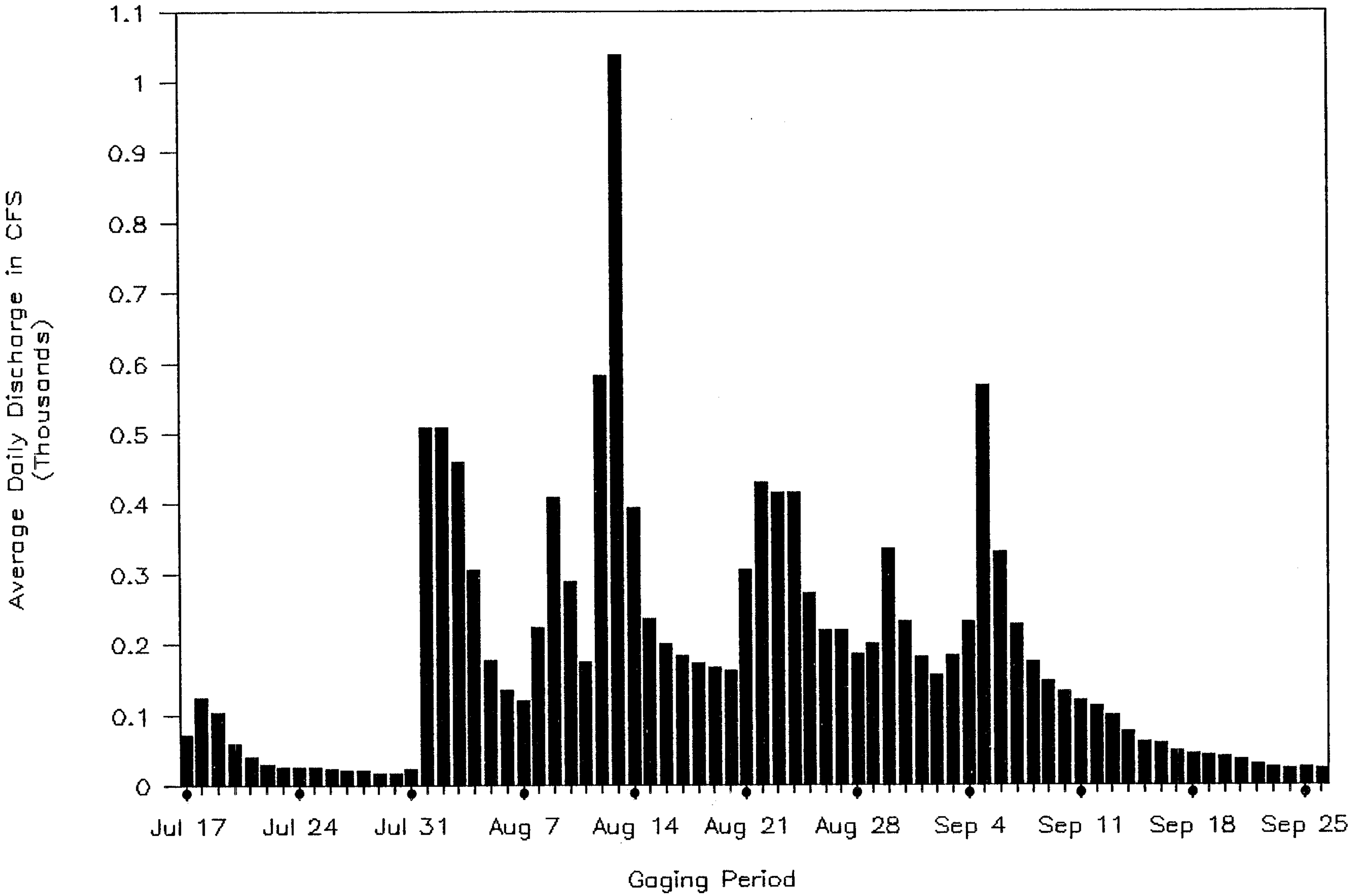
Tamayariak River

SEPTEMBER 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	181	0	205.7	2345	168.3
2	156	2345	176.9	745	139.4
3	184	2300	200.6	30	172.5
4	233	2345	495.4	1000	190.8
5	569	530	678.0	2330	436.9
6	331	30	442.4	2345	264.4
7	227	15	264.4	2330	195.6
8	175	15	198.1	2330	156.0
9	148	0	158.0	2330	141.1
10	133	15	142.9	2345	127.6
11	121	30	127.6	2330	115.4
12	111	15	115.4	2315	105.7
13	100	15	105.7	2330	87.6
14	77	1515	111.2	1000	48.0
15	63	145	76.6	1330	58.6
16	59	115	62.7	2330	51.3
17	48	1630	81.9	1300	34.4
18	45	15	51.3	2230	42.0
19	42	1745	44.9	2030	36.7
20	39	800	51.3	345	36.7
21	37	1700	42.0	1200	30.1
22	30	0	36.7	1200	23.0
23	25	30	28.1	1330	20.1
24	23	1915	67.0	700	12.6
25	26	1730	54.8	1100	17.6
26	23	1930	67.0	1300	11.8
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	3206				
AVERAGE	123		157.2		104.8
MAXIMUM	569		678.0		436.9
MINIMUM	23		28.1		11.8
ACRE FT	6359				

Main Tamayariak River Gaging Station

1988



ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

Location: Lat 69° 58'33", long 145°46'44", in the center sec 12, T.7N., R.25E., 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 61.3 mi^2 of which 0.79 mi^2 are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

Extremes: Maximum Discharge, 617.5 cfs Sept. 5, 1988; Minimum Discharge, 1.2 cfs August 6-7, 1988.

JULY 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
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10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	8	715	12.2	2015	6.7
19	8	715	13.3	2045	6.7
20	7	1030	8.6	2230	5.2
21	5	1215	6.7	2000	4.3
22	4	1230	5.6	1930	3.6
23	4	1100	5.2	2030	3.6
24	4	1115	4.7	15	3.3
25	4	645	4.3	1615	3.3
26	3	845	4.0	1815	2.6
27	3	715	4.7	1645	2.6
28	3	730	3.6	1900	2.2
29	2	1015	3.1	1900	2.0
30	2	1030	3.6	1715	1.8
31	3	1030	4.3	145	2.0
TOTAL	60				
AVERAGE	4		84.1		50.0
MAXIMUM	8		13.3		6.7
MINIMUM	2		3.1		1.8
ACRE FT	118				

ARCTIC NATIONAL WILDLIFE REFUGE
Tamayariak River, Middle Fork

AUGUST 1988

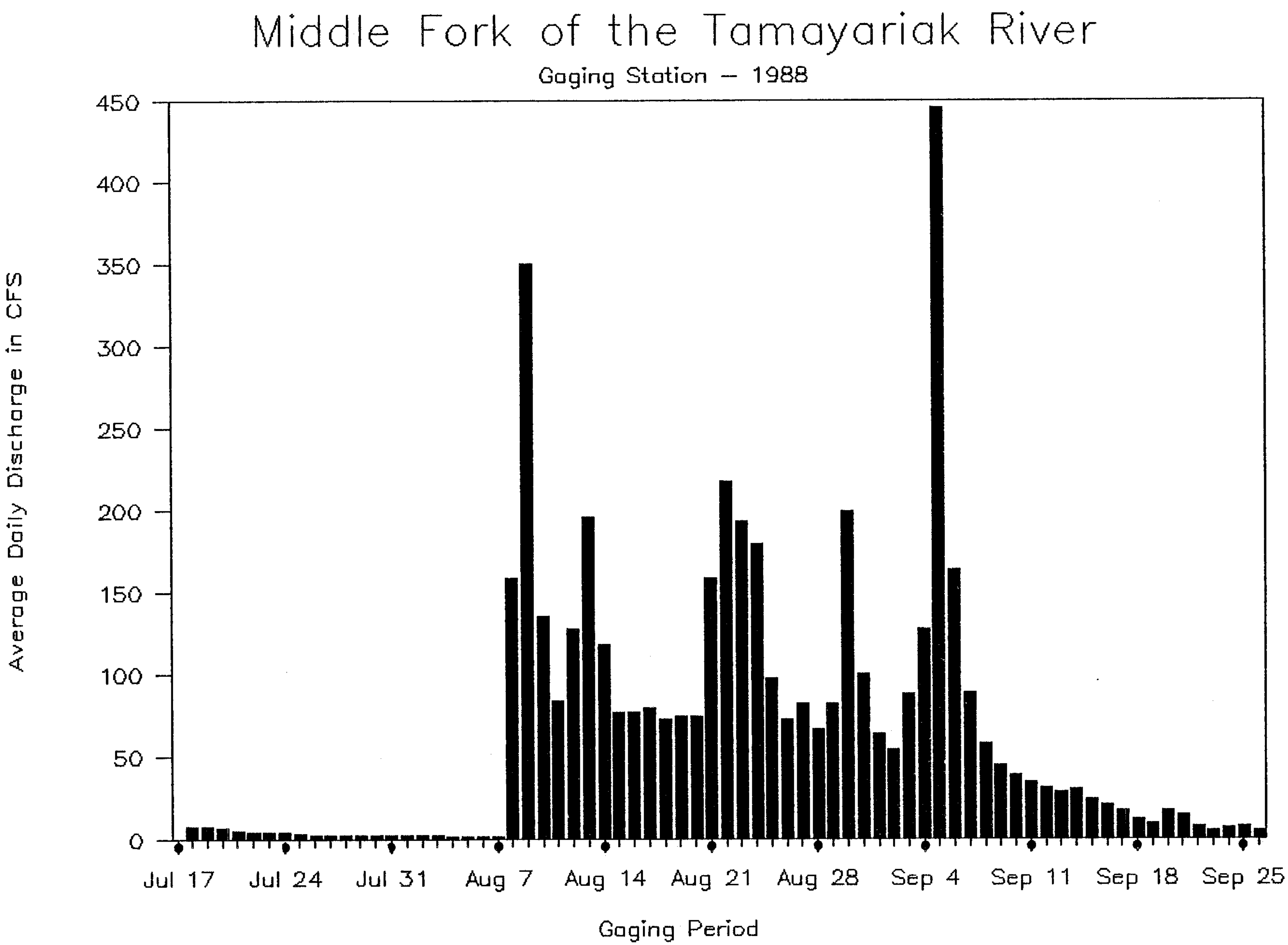
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	2	1030	2.8	1700	2.2
2	2	830	3.1	1430	1.5
3	3	445	3.6	2215	2.2
4	2	1000	2.6	2015	1.7
5	2	815	2.4	1945	1.3
6	1	730	2.0	1800	1.2
7	2	2345	5.6	1630	1.2
8	159	2300	524.2	0	6.1
9	351	145	532.1	2345	202.2
10	135	0	199.2	2345	97.5
11	84	0	97.5	1600	79.1
12	127	2345	211.4	15	82.8
13	196	445	224.4	2345	154.7
14	118	0	152.4	2345	91.9
15	77	0	91.9	2300	69.2
16	77	2145	81.5	0	69.2
17	79	15	80.3	2345	75.7
18	72	215	75.7	1245	71.3
19	75	2015	78.0	245	71.3
20	75	0	76.8	930	72.4
21	159	1830	335.4	430	72.4
22	218	0	289.0	1200	196.3
23	193	2230	241.7	1115	169.1
24	179	15	238.2	2345	129.4
25	97	0	129.4	2345	79.1
26	72	2345	82.8	1200	66.2
27	82	545	85.3	2345	74.6
28	66	0	74.6	2345	60.5
29	82	2345	238.2	800	58.8
30	199	345	256.6	2345	139.4
31	100	0	139.4	2345	79.1
TOTAL	3089				
AVERAGE	100		147.0		73.5
MAXIMUM	351		532.1		202.2
MINIMUM	1		2.0		1.2
ACRE FT	6126				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

SEPTEMBER 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	64	0	78.0	2345	57.9
2	55	2345	72.4	1315	48.4
3	88	2330	103.5	0	73.5
4	127	2345	501.3	1200	89.2
5	445	530	617.5	2345	260.4
6	164	0	256.6	2345	116.6
7	89	0	114.8	2345	70.3
8	58	0	70.3	2345	51.4
9	45	0	50.6	2345	41.7
10	39	0	41.7	2345	36.5
11	34	0	36.5	2345	32.4
12	31	0	32.4	2345	29.6
13	29	15	29.6	2330	27.9
14	31	715	47.7	215	26.3
15	24	0	26.7	1530	20.5
16	21	15	26.3	2330	17.3
17	17	730	29.2	1545	11.2
18	12	0	14.5	2345	11.2
19	9	15	11.2	1615	7.9
20	17	730	39.3	115	7.9
21	15	730	32.9	1745	6.7
22	8	745	18.8	1815	5.2
23	6	815	22.4	1830	4.0
24	7	130	24.4	945	3.6
25	8	1015	28.8	1830	3.3
26	6	1300	22.4	730	1.7
27	- - -		- - -		- - -
28	- - -		- - -		- - -
29	- - -		- - -		- - -
30	- - -		- - -		- - -
TOTAL	1449				
AVERAGE	56		90.4		40.9
MAXIMUM	445		617.5		260.4
MINIMUM	6		11.2		1.7
ACRE FT	2873				


Middle Fork of the Tamayariak River
Gaging Station – 1988
Average Daily Discharge in CFS
0
50
100
150
200
250
300
350
400
450
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Gaging Period

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

Location: Lat 69° 58'50", long 145° 47'40", NW1/4NW1/4 sec 12, T.7N., R.25E., 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 98.14 mi^2, of which 5.55 mi^2 are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

Extremes: Maximum Discharge, 495.8 cfs Sept. 5, 1988; Minimum Discharge, 9.0 cfs August 6-7, 1988.

JULY 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	17	1000	18.6	2130	16.5
18	16	545	16.5	2030	15.3
19	15	715	16.1	2130	15.0
20	15	745	15.7	2300	14.6
21	15	930	15.3	2015	14.2
22	15	830	15.0	2315	13.9
23	14	915	14.2	2100	13.9
24	15	1145	15.3	15	13.9
25	14	900	13.9	2330	13.2
26	13	1030	13.2	1630	12.6
27	13	815	12.9	1845	11.7
28	12	1100	12.3	2030	11.2
29	11	1330	11.7	2300	10.9
30	11	1015	11.4	2145	10.4
31	11	1400	12.0	0	10.6
TOTAL	206				
AVERAGE	14		14.3		13.2
MAXIMUM	17		18.6		16.5
MINIMUM	11		11.4		10.4
ACRE FT	409				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

AUGUST 1988

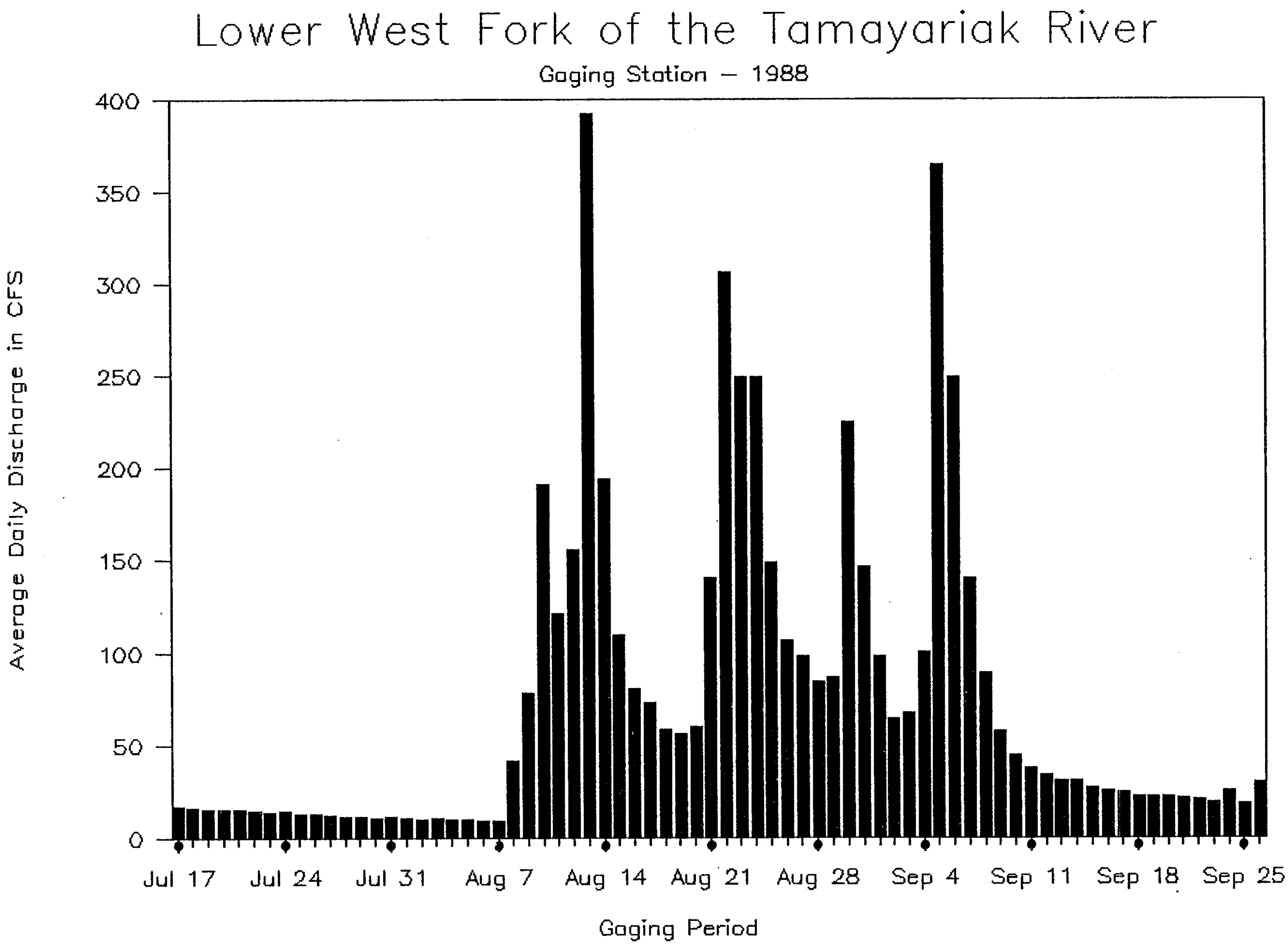
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	11	30	10.9	915	10.4
2	10	1015	10.9	2230	10.1
3	11	1100	11.2	115	10.1
4	10	0	10.6	2330	9.9
5	10	1045	10.1	2045	9.4
6	9	945	9.9	2100	9.0
7	10	2345	14.6	1700	9.0
8	42	2345	84.6	0	15.0
9	79	330	95.5	2200	58.6
10	191	330	238.4	0	109.7
11	122	0	151.4	2315	108.1
12	156	2330	386.5	415	106.5
13	392	915	467.6	2345	288.3
14	194	0	288.3	2315	140.7
15	110	100	140.7	2345	86.6
16	81	15	86.6	2130	74.8
17	73	130	76.7	2330	64.7
18	59	0	67.9	2330	54.5
19	56	1515	57.2	430	54.5
20	60	1330	63.1	30	55.9
21	141	2245	369.9	0	60.1
22	306	300	375.3	2000	260.2
23	249	315	288.3	1845	218.3
24	249	415	292.6	2245	194.2
25	149	30	197.0	2330	121.5
26	106	0	121.5	2300	93.2
27	98	1015	104.9	245	91.0
28	85	15	95.5	2345	73.0
29	87	2345	140.7	615	69.6
30	225	1015	264.1	0	142.7
31	147	30	199.9	2330	116.3
TOTAL	3525				
AVERAGE	114		152.7		87.9
MAXIMUM	392		467.6		288.3
MINIMUM	9		9.9		9.0
ACRE FT	6993				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

SEPTEMBER 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	98	15	118.0	2345	76.7
2	65	100	76.7	2230	58.6
3	68	1700	78.6	430	57.2
4	100	2345	172.7	130	73.0
5	364	1430	495.8	0	177.8
6	249	200	354.0	2330	180.4
7	141	15	180.4	2230	112.9
8	89	0	112.9	2345	67.9
9	57	45	67.9	2345	49.4
10	45	45	49.4	2230	40.7
11	38	30	40.7	2345	35.1
12	33	15	35.1	2245	31.9
13	31	0	31.9	2345	28.9
14	31	845	47.1	2345	26.9
15	27	30	27.5	2000	25.6
16	26	130	26.9	2245	24.4
17	24	745	25.6	2345	23.2
18	23	430	23.2	2215	21.6
19	23	1600	23.8	0	22.1
20	23	1130	25.6	615	20.5
21	22	530	23.2	230	20.0
22	21	930	22.1	2100	19.6
23	19	1030	22.1	2230	16.1
24	26	1015	67.9	0	17.7
25	18	1030	28.2	230	13.9
26	30	930	50.7	0	18.6
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	1689				
AVERAGE	65		85.7		48.5
MAXIMUM	364		495.8		180.4
MINIMUM	18		22.1		13.9
ACRE FT	3349				


Lower West Fork of the Tamayariak River
Gaging Station – 1988
Average Daily Discharge in CFS
400
350
300
250
200
150
100
50
0
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Gaging Period

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

Location: Lat 69° 49'58", Long 145° 55'15", in the center W1/2W1/2 sec 33, T.6N., R.25E., 13.9 miles upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 49.2 mi^2, of which 5.6 mi^2 are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

Extremes: Maximum Discharge, 404 cfs Aug 13, 1988; Minimum Discharge, 0.8 cfs July 29-31, 1988.

JULY 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	3	0	3.9	1345	2.8
19	2	0	2.9	2345	2.2
20	2	0	2.2	2345	1.4
21	1	0	1.4	2345	1.0
22	1	0	1.0	1945	0.9
23	1	2315	1.0	1415	0.9
24	1	1715	1.1	0	1.0
25	1	0	1.1	1200	1.0
26	1	2030	1.0	930	0.9
27	1	0	1.0	930	0.9
28	1	2030	1.0	545	0.9
29	1	0	1.0	1500	0.8
30	1	1830	0.9	945	0.8
31	1	1930	1.2	530	0.8
TOTAL	17.7				
AVERAGE	1.3		1.5		1.2
MAXIMUM	3.1		3.9		2.8
MINIMUM	0.8		0.9		0.8
ACRE FT	35.0				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

AUGUST 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	1	1445	1.3	845	1.1
2	1	0	1.2	2345	1.0
3	1	845	1.4	230	1.0
4	1	15	1.2	2345	1.0
5	1	2245	1.2	545	1.0
6	1	1800	1.3	530	1.2
7	2	2345	4.9	700	1.2
8	88	2315	281.9	0	5.2
9	240	500	311.5	2345	157.8
10	106	0	161.0	2330	73.8
11	60	0	72.4	2045	55.8
12	168	2130	373.0	0	60.4
13	271	315	404.1	2345	167.6
14	110	0	161.0	2330	75.3
15	60	0	75.3	1900	53.6
16	54	15	54.7	2330	51.5
17	48	100	51.5	2345	44.8
18	43	115	44.8	2245	40.5
19	41	1600	42.2	630	39.7
20	42	2145	47.5	745	38.9
21	143	1900	281.9	130	44.8
22	217	15	265.5	830	200.6
23	189	2330	235.5	1145	157.8
24	178	15	230.8	2330	126.7
25	94	0	126.7	2345	70.9
26	64	0	72.4	1115	58.1
27	65	300	69.5	2345	59.2
28	54	45	59.2	2345	48.5
29	70	2345	167.6	445	46.6
30	143	200	171.0	2345	107.9
31	78	15	107.9	2345	60.4
TOTAL	2636				
AVERAGE	85		125.2		59.8
MAXIMUM	271		404.1		200.6
MINIMUM	1		1.2		1.0
ACRE FT	5228				

ARCTIC NATIONAL WILDLIFE REFUGE

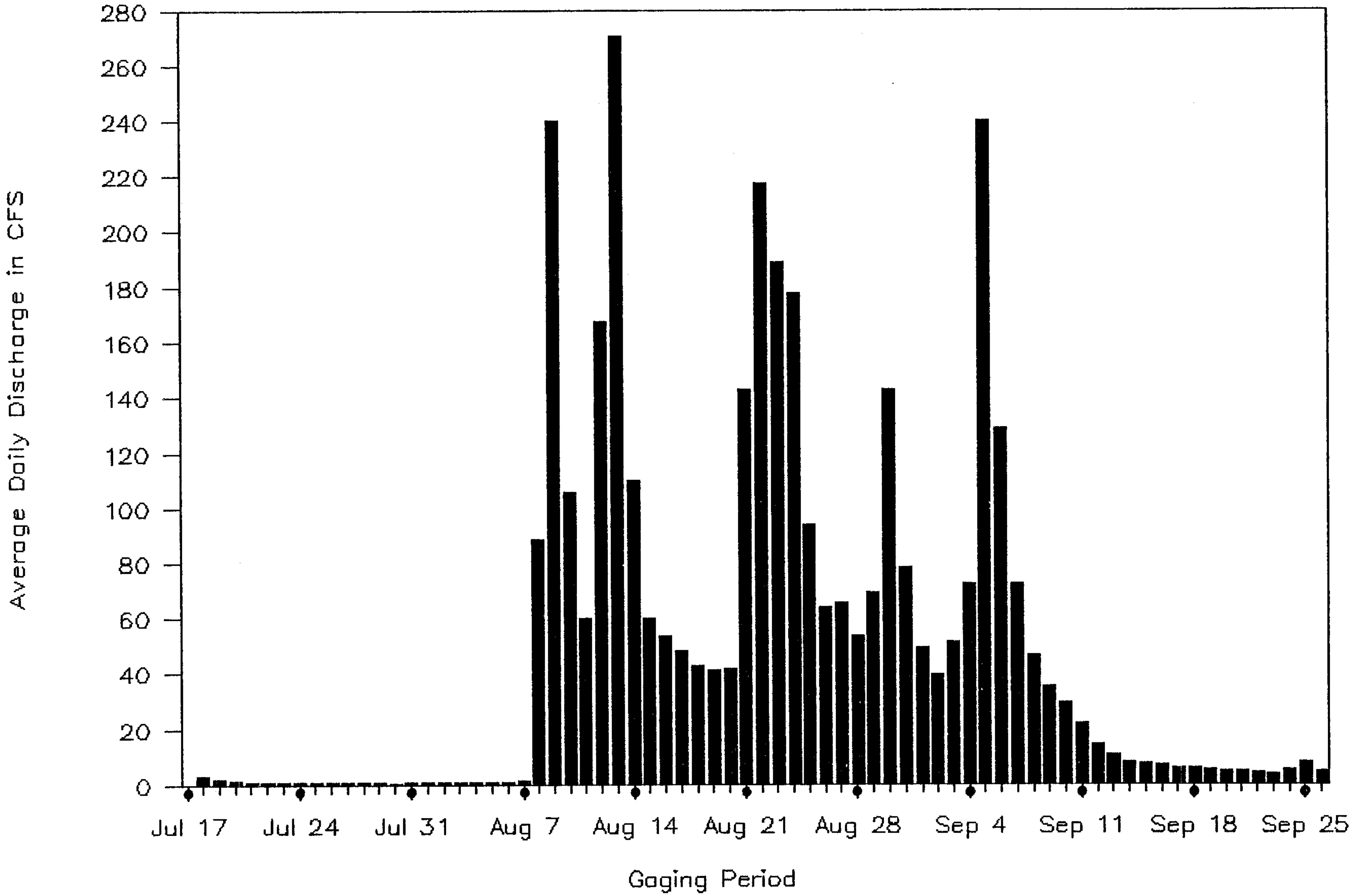
Tamayariak River, Upper West Fork

SEPTEMBER 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	49	0	61.7	2230	43.0
2	40	2345	50.5	615	30.6
3	51	2330	58.1	830	48.5
4	72	2345	217.4	1045	53.6
5	240	1000	276.3	2345	192.8
6	129	15	192.8	2345	93.8
7	72	15	93.8	2345	56.9
8	47	15	56.9	2330	40.5
9	35	0	40.5	2300	32.5
10	29	0	32.5	2345	27.6
11	22	0	26.0	2345	17.4
12	15	30	17.4	2345	12.3
13	11	0	12.3	745	9.2
14	8	1045	19.5	800	2.5
15	7	0	8.2	915	6.5
16	7	0	7.8	2330	6.5
17	6	1500	7.8	645	3.3
18	6	0	6.5	2330	5.2
19	5	45	5.2	2345	4.9
20	5	1815	5.8	615	3.9
21	5	1730	5.8	715	3.7
22	4	0	5.5	800	3.5
23	4	1245	5.5	445	2.6
24	5	515	11.0	1015	2.9
25	8	515	19.5	1830	3.3
26	5	45	8.7	945	2.8
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	890				
AVERAGE	34		48.2		27.3
MAXIMUM	240		276.3		192.8
MINIMUM	4		5.2		2.5
ACRE FT	1764				

Upper West Fork of the Tamayariak River :

Gaging Station — 1988



APPENDIX C

Surface water temperature records

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek

Location: Lat 69° 52'35", long 144° 22', in SE1/4NW1/4 sec. 15, T.6N., R.31E., 6 miles upstream from the confluence with the Sadlerochit River, 24 miles southwest of Kaktovik, Alaska.

Drainage Area: 120.4 mi^2, of which 39 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals.

Extremes: Maximum Temperature 14.9 °c, July 28, 1988; Minimum Temperature 0.7 °c, September 26, 1989.

JULY 1988

DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	---	---	---	---	---
18	---	---	---	---	---
19	---	---	---	---	---
20	8.5	1715	9.7	2345	7.1
21	7.2	1545	9.3	715	5.7
22	6.6	1715	9	630	4.8
23	7	1715	8.8	700	5.3
24	7.5	1745	9.7	500	5.9
25	9.2	1630	11	415	6.9
26	9.7	1445	12.2	500	7.6
27	11	1615	14	400	8.1
28	12	1700	14.9	445	9.2
29	11.8	1345	14.4	500	9.4
30	10.8	1430	12	515	9.6
31	10.9	1600	12.4	615	9.8
AVERAGE	9.4		11.5		7.5
MAXIMUM	12.0		14.9		9.8
MINIMUM	6.6		8.8		4.8

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek

AUGUST 1988

DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	9.8	1030	11	2345	8.3
2	10.3	1545	13.6	345	7.9
3	8.9	0	10.7	2345	6.8
4	8.2	1745	10.4	430	6.2
5	9.7	1630	12.9	500	6.4
6	10.9	1500	13.6	445	8
7	11.4	1445	13.6	2345	8.5
8	7.2	0	8.4	700	6.2
9	7.6	1715	9.9	415	6
10	8.7	1615	11.9	515	5.5
11	9.4	1500	11.9	515	7.6
12	8.4	0	9.8	2345	6.9
13	8.5	1600	11.1	430	6.4
14	10	1615	12.9	545	7.3
15	10.7	1345	11.8	515	9.8
16	10.4	1645	11.7	515	9.2
17	11.5	1545	14.4	615	9
18	10.8	0	12	2345	9.1
19	8.5	1530	10.3	2345	6.8
20	7.4	1330	9.9	700	5.7
21	7.2	1545	8.5	530	6.1
22	5.8	0	7	2345	4.9
23	5.1	1615	6	700	4.4
24	5.8	1515	7.5	600	4.6
25	5.5	1530	6.5	2345	4.6
26	5.1	1845	6	600	4.2
27	5.2	1515	6.6	515	4.3
28	4.8	1600	5.9	530	3.9
29	4.2	1345	5	2330	2.5
30	2.9	1430	4.2	545	1.9
31	2.8	1445	4	545	1.7
AVERAGE	7.8		9.6		6.2
MAXIMUM	11.5		14.4		9.8
MINIMUM	2.8		4.0		1.7

ARCTIC NATIONAL WILDLIFE REFUGE

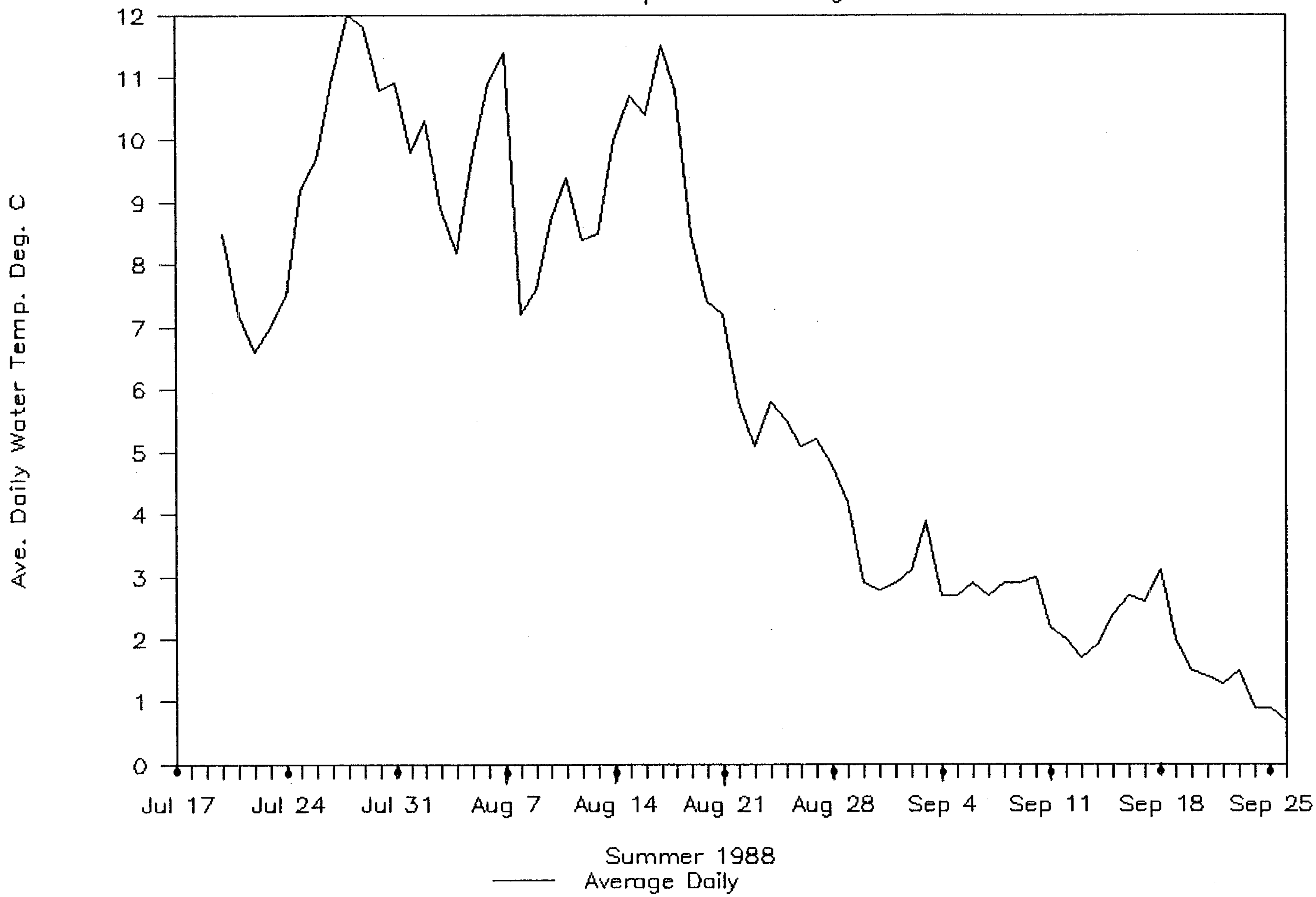
Itkilyariak Creek

SEPTEMBER 1988

DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	2.9	1500	4.4	600	1.7
2	3.1	1600	5.5	645	0.8
3	3.9	1615	6.5	600	1.5
4	2.7	0	3.5	2345	2.3
5	2.7	1645	3.6	715	1.8
6	2.9	1530	3.4	745	2.5
7	2.7	1615	4.2	800	1.8
8	2.9	1615	5.2	715	0.9
9	2.9	1530	4.8	630	1.3
10	3	1615	4.4	715	1.8
11	2.2	1330	2.7	715	1.6
12	2	1430	2.9	2345	1.2
13	1.7	1515	3.4	630	0.7
14	1.9	1615	4	45	0.6
15	2.4	1530	4.3	530	0.8
16	2.7	1515	4.6	800	1.4
17	2.6	1515	4.7	630	0.7
18	3.1	1545	4.8	500	1.7
19	2	0	2.8	815	1.7
20	1.5	1545	2.2	800	0.7
21	1.4	1445	2.5	500	0.7
22	1.3	1415	2.9	630	0.6
23	1.5	1445	2.8	630	0.7
24	0.9	1500	1.8	200	0.6
25	0.9	1430	1.5	2045	0.5
26	0.7	1545	1.2	1845	0.5
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	2.3		3.6		1.2
MAXIMUM	3.9		6.5		2.5
MINIMUM	0.7		1.2		0.5

Itkilyariak Creek

Water Temperature Readings



ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

Location: Lat 69 38', long 144 22'50", in NW1/4SW1/4 sec. 31, T.4N., R.32E., 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

Drainage Area: 520.1 mi , of which 517.5 mi is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi depending on existing climatic conditions.

Remarks: Temperatures were recorded at 15 minute intervals.

Extremes: Maximum Temperature 14.9 c, July 28, 1988; Minimum Temperature -0.1 c, September 27, 1988.

JULY 1988

DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	7.3	0	8.4	815	6.5
22	6.9	1930	8.1	830	5.9
23	7.6	1515	9.8	715	5.8
24	7.7	2030	9.5	800	6.2
25	9.6	1645	11.7	530	7.3
26	10.6	1715	13.7	615	8.1
27	11.7	1530	14.3	615	9.2
28	12.1	1700	14.9	530	9.3
29	11.7	1600	14.5	545	9.5
30	10.8	1430	12	715	9.9
31	10.6	1600	12	2345	9.4
AVERAGE	9.7		11.7		7.9
MAXIMUM	12.1		14.9		9.9
MINIMUM	6.9		8.1		5.8

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

AUGUST 1988

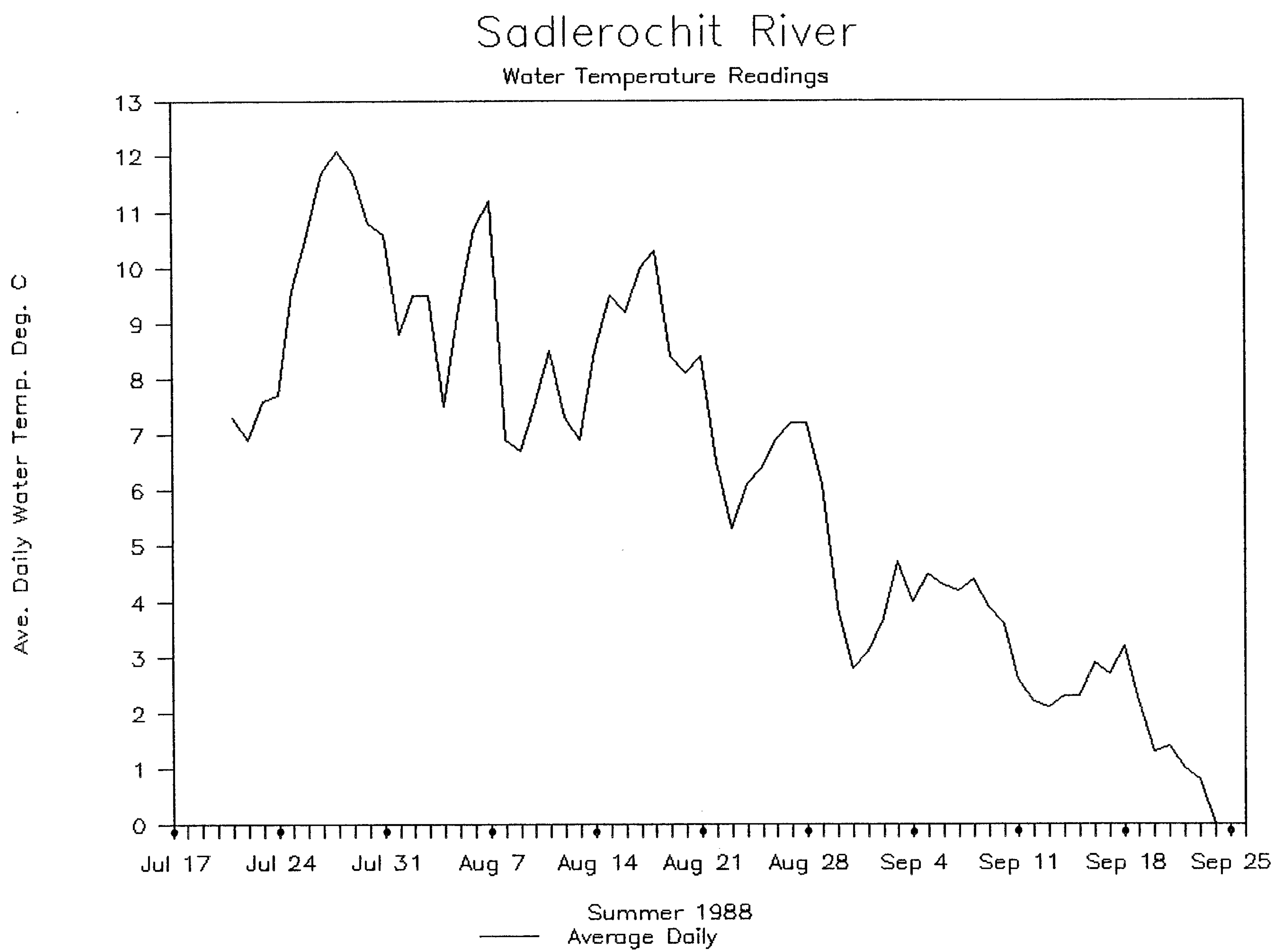
DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	8.8	1845	10.7	715	6.5
2	9.5	1730	12.5	615	6.9
3	9.5	0	11.1	2345	6.9
4	7.5	1915	10.2	545	5.1
5	9.3	1815	12.4	630	6.2
6	10.7	1800	12.6	615	8.3
7	11.2	1515	13.1	730	9.9
8	6.9	0	10.1	2345	5.7
9	6.7	1745	9.1	600	5
10	7.5	1845	10.3	630	4.6
11	8.5	2000	10.2	800	6.9
12	7.3	0	9.3	2345	5.4
13	6.9	2000	9.6	600	4.5
14	8.5	1745	10.8	645	6.1
15	9.5	1815	10.1	730	8.8
16	9.2	1900	10.6	745	8
17	10	1715	12.4	645	7.5
18	10.3	0	11.3	2345	9.4
19	8.4	1645	9.4	745	7.5
20	8.1	1415	9.5	715	6.5
21	8.4	1615	9.3	715	7.7
22	6.5	0	8.2	2345	5.5
23	5.3	1800	6.2	730	4.7
24	6.1	1915	7.8	630	4.7
25	6.4	1730	7.6	745	5.1
26	6.9	1945	8	615	5.6
27	7.2	1900	8.1	815	6
28	7.2	1545	8.6	730	5.9
29	6.1	0	7.5	2345	4.2
30	3.9	1715	4.8	800	3
31	2.8	1600	3.5	745	2
AVERAGE	7.8		9.5		6.1
MAXIMUM	11.2		13.1		9.9
MINIMUM	2.8		3.5		2.0

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

SEPTEMBER 1988

DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	3.1	1845	4.5	615	1.8
2	3.7	1845	5.4	700	1.5
3	4.7	1730	6.9	715	2.4
4	4	0	5.2	700	3.3
5	4.5	1530	5.4	830	3.8
6	4.3	1745	5	1000	3.7
7	4.2	1630	5.3	800	3.2
8	4.4	1700	6.4	800	2.4
9	3.9	1700	5.4	800	2.2
10	3.6	1645	5.4	745	1.8
11	2.6	0	3.5	830	2
12	2.2	1630	3.1	730	1.5
13	2.1	1600	3.7	730	0.9
14	2.3	1715	4.3	745	0.6
15	2.3	1715	3.6	730	0.9
16	2.9	1630	5	815	1.2
17	2.7	1645	4.6	800	0.7
18	3.2	1700	5.3	645	1.5
19	2.2	0	3.3	2345	1.7
20	1.3	1530	1.7	915	0.5
21	1.4	1600	2.8	745	0.4
22	1	1645	2	930	0.3
23	0.8	1630	1.9	745	-0.1
24	0	1800	0.2	200	-0.2
25	0	1715	0.5	2300	-0.2
26	0	1615	0.7	0	-0.1
27	-0.1	1400	0.1	0	-0.1
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	2.5		3.7		1.4
MAXIMUM	4.7		6.9		3.8
MINIMUM	-0.1		0.1		-0.2


Sadlerochit River
Water Temperature Readings
Ave. Daily Water Temp. Deg. C
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Summer 1988
Average Daily

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

Location: Lat 69° 49'58", long 145° 33'10", in SW1/4NE1/4 sec. 35, T.6N., R.26E., 11.8 miles upstream from the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 136.1 mi^2, of which 56.8 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals. A malfunction occurred Aug. 11-12, 1988.

Extremes: Maximum Temperature 16.4 C, July 28, 1988.

JULY 1988

DATE	TEMP DEG. C AVG	TIME OF MAX.T	TEMP DEG.C MAX	TIME OF MIN.T	TEMP DEG.C MIN
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	12.5	0	14.5	1030	11.1
18	12	1345	13.6	530	10.1
19	11.3	1200	12	2345	10.3
20	10	1745	10.7	2345	8.6
21	8	1530	9.8	815	6.6
22	7.4	1845	9.7	715	5.4
23	8.4	1745	10.9	515	6.4
24	8.9	1745	11.5	630	7
25	10.7	1515	13.1	500	8.3
26	11.7	1645	15.1	545	8.5
27	12.3	1800	15.2	600	9.2
28	13	1600	16.4	445	9.6
29	12.5	1745	15.5	530	9.4
29	12.5	1630	15	445	10.5
30	12.5	1645	12.4	700	10.6
AVERAGE	10.9		13.0		8.8
MAXIMUM	13.0		16.4		11.1
MINIMUM	7.4		9.7		5.4

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

AUGUST 1988

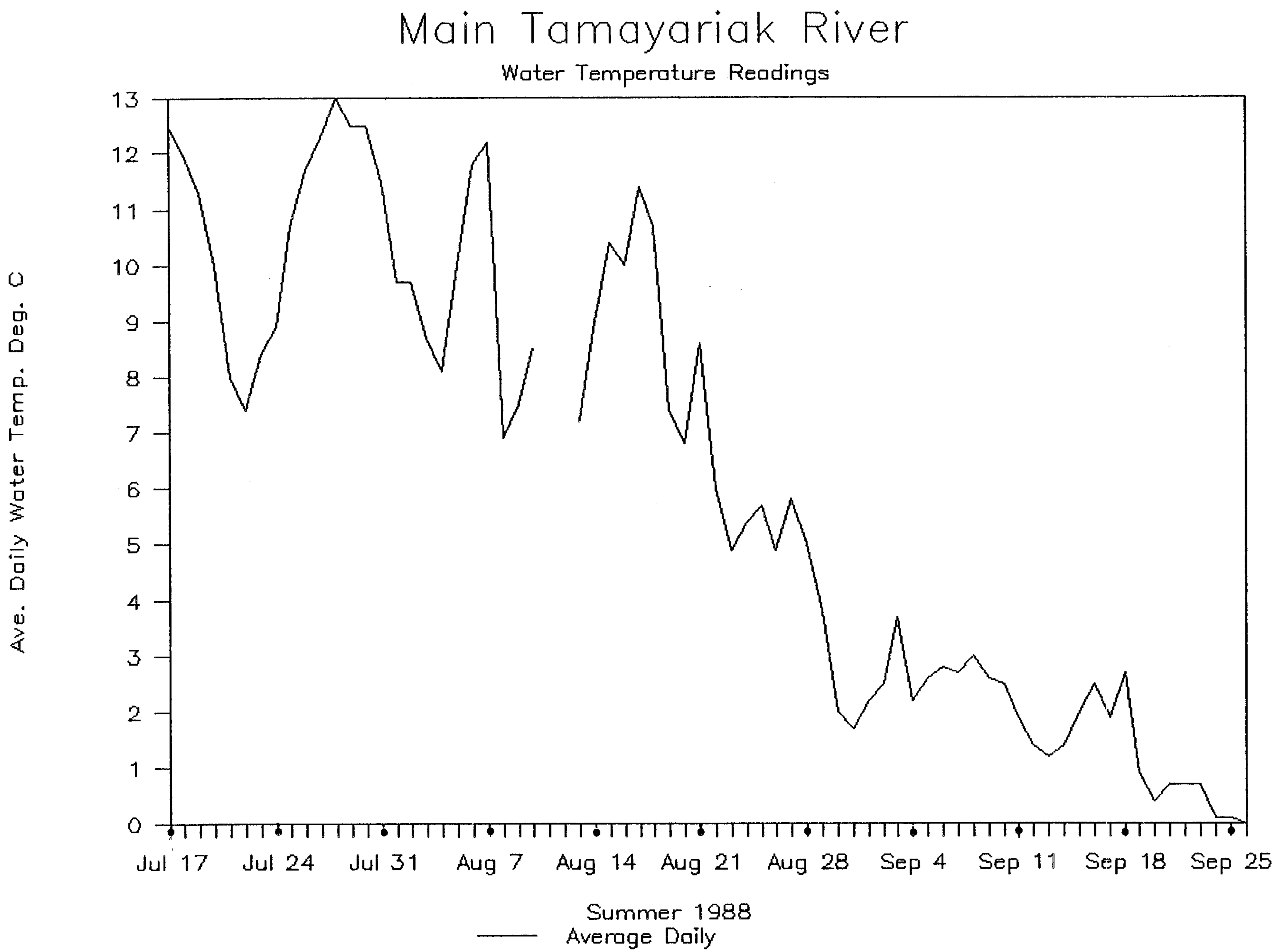
DATE	TEMP DEG. C AVG	TIME OF MAX.T	TEMP DEG.C MAX	TIME OF MIN.T	TEMP DEG.C MIN
1	9.7	0	10.5	2345	8
2	9.7	1530	12.8	445	7
3	8.7	0	10.6	2345	6.5
4	8.1	1800	11.2	645	5.2
5	10	1745	14.1	600	5.9
6	11.8	1530	14.7	530	8.8
7	12.2	1515	14.1	2345	9
8	6.9	0	8.9	2345	6
9	7.5	1700	10.9	545	4.9
10	8.5	1715	12.3	615	4.7
11					
12					
13	7.2	1845	10.4	530	4.6
14	9	1645	12.3	600	5.8
15	10.4	1715	11.6	630	9.1
16	10	1700	11.8	630	8.3
17	11.4	1715	14.1	630	8.7
18	10.7	0	12.1	2345	8.9
19	7.4	1545	8.8	2345	5.6
20	6.8	1515	9.6	645	4.7
21	8.6	1545	11.1	630	6.8
22	6	0	8.1	2345	4.8
23	4.9	1400	6.2	645	3.5
24	5.4	1645	7.4	615	3.8
25	5.7	1630	8.2	700	4
26	4.9	1900	5.9	615	3.8
27	5.8	1715	7.6	715	4.2
28	5	1645	6.3	645	3.8
29	3.8	0	4.9	2345	1.8
29	2	1615	3.4	600	0.8
30	1.7	1745	3.6	630	0
AVERAGE	7.6		9.8		5.5
MAXIMUM	12.2		14.7		9.1
MINIMUM	1.7		3.4		0.0

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

SEPTEMBER 1988

DATE	TEMP DEG. C AVG	TIME OF MAX.T	TEMP DEG.C MAX	TIME OF MIN.T	TEMP DEG.C MIN
1	2.2	1645	4.2	645	0.6
2	2.5	1730	5.2	615	-0.1
3	3.7	1700	6.8	615	0.8
4	2.2	0	4.1	800	1.5
5	2.6	1615	4.1	645	1.4
6	2.8	1700	3.8	800	2.1
7	2.7	1600	4.5	715	1.2
8	3	1715	6	700	0.3
9	2.6	1515	4.3	730	0.7
10	2.5	1615	4.7	730	0.5
11	1.9	1730	2.6	745	1.1
12	1.4	1515	2.5	800	0.6
13	1.2	1630	3.1	630	-0.1
14	1.4	1630	3.9	315	-0.1
15	2	1615	3.9	445	0.2
16	2.5	1630	4.7	730	0.5
17	1.9	1700	4.4	545	-0.1
18	2.7	1615	4.7	730	1.2
19	0.9	0	2.4	2345	0.4
20	0.4	1630	0.9	715	-0.1
21	0.7	1630	2.1	600	-0.1
22	0.7	1645	2	415	-0.1
23	0.7	1600	2.4	645	-0.1
24	0.1	1615	1	2115	-0.1
25	0.1	1545	0.8	2000	-0.1
26	0	1530	0.5	1815	-0.1
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	1.7		3.4		0.5
MAXIMUM	3.7		6.8		2.1
MINIMUM	0.0		0.5		-0.1



Main Tamayariak River
Water Temperature Readings
Ave. Daily Water Temp. Deg. C
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Summer 1988
Average Daily

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

Location: Lat 69° 58'33", long 145° 46'44", in the center sec 12, T.7N., R.25E., 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 61.3 mi^2, of which 0.79 mi2 are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals.

Extremes: Maximum Temperature 14.2 °c, July 28, 1988; Minimum Temperature 0 °c, Sept. 26, 1988.

JULY 1988

DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17					
18	11.3	1745	13.9	500	8.7
19	10.1	1215	11.3	515	8.9
20	9.3	1215	10.7	2345	7.9
21	7.8	1630	10.2	645	6.4
22	7.1	1630	9.9	545	5
23	6.3	1815	7.8	630	5.1
24	7.3	1745	9.8	415	5.2
25	8.1	1415	9.8	500	6.2
26	9.2	1330	12.1	400	6.4
27	10.1	1500	13.8	515	7
28	10.5	1515	14.2	500	7.3
29	10.1	1445	13.1	515	7.8
30	10.2	1500	13.7	500	7.7
31	10.6	1430	12.9	515	8.5
AVERAGE	9.1		11.7		7.0
MAXIMUM	11.3		14.2		8.9
MINIMUM	6.3		7.8		5.0

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

AUGUST 1988

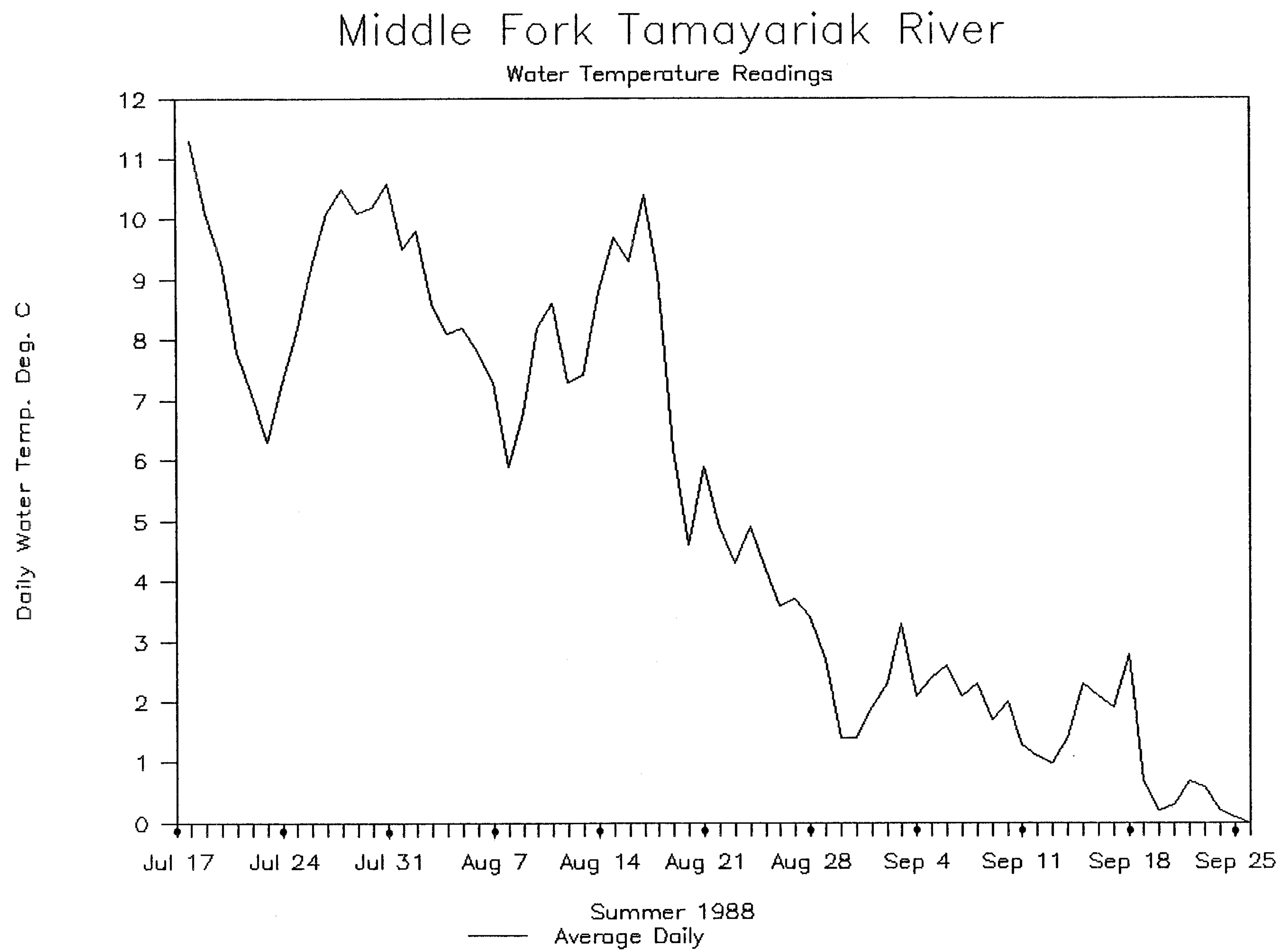
DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	9.5	1030	10.5	2345	8.1
2	9.8	1515	12.9	500	7.5
3	8.6	0	10	2345	6.8
4	8.1	1415	10.9	445	6
5	8.2	1745	11.5	545	5.4
6	7.8	1615	10.4	630	5.9
7	7.3	1800	9.6	800	6.1
8	5.9	0	7.2	900	5.1
9	6.8	1730	9.8	545	4.4
10	8.2	1645	11.5	615	5.2
11	8.6	1630	10.8	615	6.6
12	7.3	0	9.1	2345	6
13	7.4	1715	10	600	5.3
14	8.8	1630	12.1	600	5.9
15	9.7	1700	10.7	630	8.8
16	9.3	1745	10.8	600	8
17	10.4	1615	13	630	7.8
18	9.1	0	10.9	2345	6.9
19	6.2	1500	7.8	2345	4.6
20	4.6	1615	6	545	3.5
21	5.9	1730	8.3	445	4.1
22	4.9	0	6.5	2345	4.1
23	4.3	1600	5.6	830	3
24	4.9	1645	6.8	715	3.5
25	4.2	1645	5.1	2345	3.4
26	3.6	1845	4.4	415	3
27	3.7	1645	4.8	645	2.9
28	3.4	1630	4.6	615	2.4
29	2.7	1430	3.3	2345	1.4
30	1.4	1545	2.5	630	0.4
31	1.4	1645	2.8	600	0.4
AVERAGE	6.5		8.4		4.9
MAXIMUM	10.4		13.0		8.8
MINIMUM	1.4		2.5		0.4

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

SEPTEMBER 1988

DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	1.9	1500	3.7	615	0.7
2	2.3	1645	5.1	530	0
3	3.3	1645	6.1	615	0.8
4	2.1	0	3.2	2345	1.7
5	2.4	1600	3.6	700	1.3
6	2.6	1700	3.3	2345	2
7	2.1	1615	3.7	800	0.9
8	2.3	1700	4.9	700	0.1
9	1.7	1630	3	730	0.3
10	2	1645	3.5	730	0.7
11	1.3	0	2	945	0.8
12	1.1	1600	2.1	700	0.5
13	1	1630	2.7	600	0
14	1.4	1645	4	145	0
15	2.3	1500	4.2	345	0.6
16	2.1	1615	4.2	745	0.5
17	1.9	1700	4.4	515	0
18	2.8	1545	4.7	645	1.6
19	0.7	0	2	2345	0.3
20	0.2	1545	0.7	515	0
21	0.3	1645	1.1	0	0
22	0.7	630	1.8	130	0
23	0.6	1515	1.9	630	0
24	0.2	1600	0.9	2345	0
25	0.1	1400	0.8	1900	0
26	0	1545	0.3	2015	0
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	1.5		3.0		0.5
MAXIMUM	3.3		6.1		2.0
MINIMUM	0.0		0.3		0.0


Middle Fork Tamayariak River
Water Temperature Readings
Daily Water Temp. Deg. C
12
11
10
9
8
7
6
5
4
3
2
1
0
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Summer 1988
Average Daily

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

Location: Lat 69° 58'50", long 145° 47'40", NW1/4NW1/4 sec 12, T.7N., R.25E., 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 98.1 mi^2, of which 5.6 mi^2 are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals.

Extremes: Maximum Temperature 12.2 °c, July 18, 1988; Minimum Temperature 0 °c, September 24-26, 1988.

JULY 1988

DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	9.2	1815	10.3	2345	8.3
18	9.9	1630	12.2	415	7.5
19	8.8	1200	9.9	445	7.7
20	8.1	1215	9.4	2345	6.8
21	6.8	1630	8.9	615	5.6
22	6.2	1700	8.6	530	4.5
23	5.6	1815	6.8	630	4.5
24	6.3	1730	8.3	415	4.5
25	6.9	1400	8.4	515	5.3
26	7.8	1630	10.1	345	5.4
27	8.6	1415	11.4	515	6.1
28	9.1	1515	12	430	6.4
29	8.7	1630	11	530	6.8
30	9	1430	11.9	400	6.9
31	9.5	1600	11.2	500	7.9
AVERAGE	8.0		10.0		6.3
MAXIMUM	9.9		12.2		8.3
MINIMUM	5.6		6.8		4.5

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

AUGUST 1988

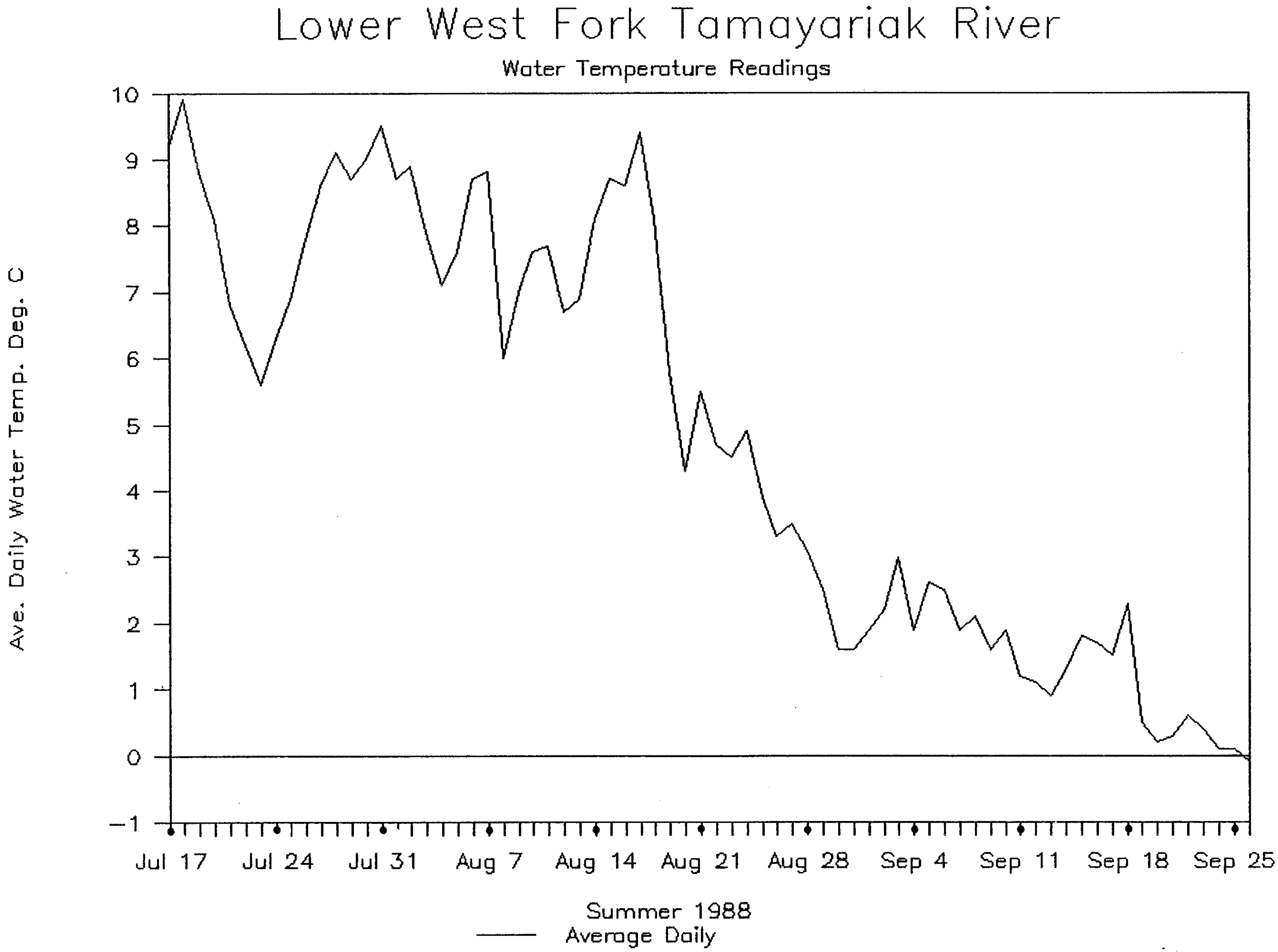
DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	8.7	1030	9.5	2345	7.2
2	8.9	1415	11.4	430	6.7
3	7.9	30	9.3	2345	6.1
4	7.1	1330	9.4	430	5.4
5	7.6	1600	10.4	515	5.2
6	8.7	1615	12.1	445	5.7
7	8.8	1445	10.9	2345	6.5
8	6	1715	6.7	630	5.1
9	7	1700	9.6	330	5
10	7.6	1615	10.6	530	4.9
11	7.7	1515	9.7	500	5.9
12	6.7	0	8.1	2345	5.7
13	6.9	1630	9.2	530	5.2
14	8.1	1615	11.2	530	5.4
15	8.7	1615	9.7	530	7.8
16	8.6	1645	10.2	500	7.3
17	9.4	1445	12	615	7.1
18	8.1	0	9.5	2345	6.2
19	5.8	1500	7.3	2345	4.2
20	4.3	1530	5.6	515	3.4
21	5.5	1600	7.7	245	3.9
22	4.7	0	5.4	2345	4.2
23	4.5	1530	5.9	700	3.3
24	4.9	1630	6.5	630	3.6
25	3.9	1545	4.8	2345	2.9
26	3.3	1830	4.1	245	2.7
27	3.5	1600	4.4	2345	2.6
28	3.1	1545	4.1	545	2.2
29	2.5	1430	3.1	2345	1.3
30	1.6	1530	2.6	530	0.7
31	1.6	1645	2.7	530	0.8
AVERAGE	6.2		7.9		4.7
MAXIMUM	9.4		12.1		7.8
MINIMUM	1.6		2.6		0.7

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

SEPTEMBER 1988

DATE	AVE.WATER TEMP DEG.C	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	MIN TEMP DEG.C
1	1.9	1500	3.3	545	0.8
2	2.2	1615	4.7	445	0.2
3	3	1600	5.7	545	0.9
4	1.9	0	2.4	545	1.5
5	2.6	1630	3.6	315	1.7
6	2.5	1600	3.2	2345	1.8
7	1.9	1545	3.2	630	0.9
8	2.1	1630	4.4	700	0.4
9	1.6	1500	2.8	645	0.5
10	1.9	1515	3.3	715	0.9
11	1.2	0	1.6	2345	0.8
12	1.1	1500	1.9	2345	0.5
13	0.9	1545	2.4	630	0.1
14	1.3	1630	3.5	330	-0.1
15	1.8	1515	3.6	330	0.4
16	1.7	1600	3.5	745	0.3
17	1.5	1615	3.8	600	-0.1
18	2.3	1545	3.8	45	1.2
19	0.5	0	1.5	815	0.2
20	0.2	1430	0.6	530	-0.1
21	0.3	1615	1.1	515	-0.1
22	0.6	1530	1.7	515	-0.1
23	0.4	1515	1.5	615	-0.1
24	0.1	1600	0.6	2215	-0.1
25	0.1	1545	0.8	115	-0.1
26	-0.1	1545	0.2	1815	-0.1
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	1.4		2.6		0.5
MAXIMUM	3.0		5.7		1.8
MINIMUM	-0.1		0.2		-0.1



Lower West Fork Tamayariak River
Water Temperature Readings
Ave. Daily Water Temp. Deg. C
10
9
8
7
6
5
4
3
2
1
0
−1
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Summer 1988
Average Daily

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

Location: Lat 69° 49'58", Long 145° 55'15", in the center W1/2W1/2 sec 33, T.6N., R.25E., 13.9 miles upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 49.2 mi^2, of which 5.6 mi^2 are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals.

Extremes: Maximum Temperature 15 °c, Aug. 6, 1988; Minimum Temperature 0 °c, September 24-26, 1988.

JULY 1988

DATE	TEMP DEG.C AVG	TIME OF MAX.T	MAX TEMP DEG.C	TIME OF MIN.T	TEMP DEG.C MIN
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	11.8	1615	13.5	500	9.5
19	11.3	1745	12.2	2345	10.4
20	10	1445	11	2345	8.6
21	8	1345	9.7	2345	6.8
22	7.3	1645	9.2	615	5.7
23	8.3	1630	10.7	530	6.3
24	8.8	1715	11.1	515	7.2
25	10.1	1330	11.9	445	8.5
26	10.6	1330	12.8	445	8.3
27	11.2	1445	13.6	530	8.6
28	12.1	1415	14.9	415	9.4
29	12.1	1345	14.3	445	9.8
30	12.1	1415	14.3	315	10.5
31	11.5	645	12.3	2345	10.6
AVERAGE	10.4		12.3		8.6
MAXIMUM	12.1		14.9		10.6
MINIMUM	7.3		9.2		5.7

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

AUGUST 1988

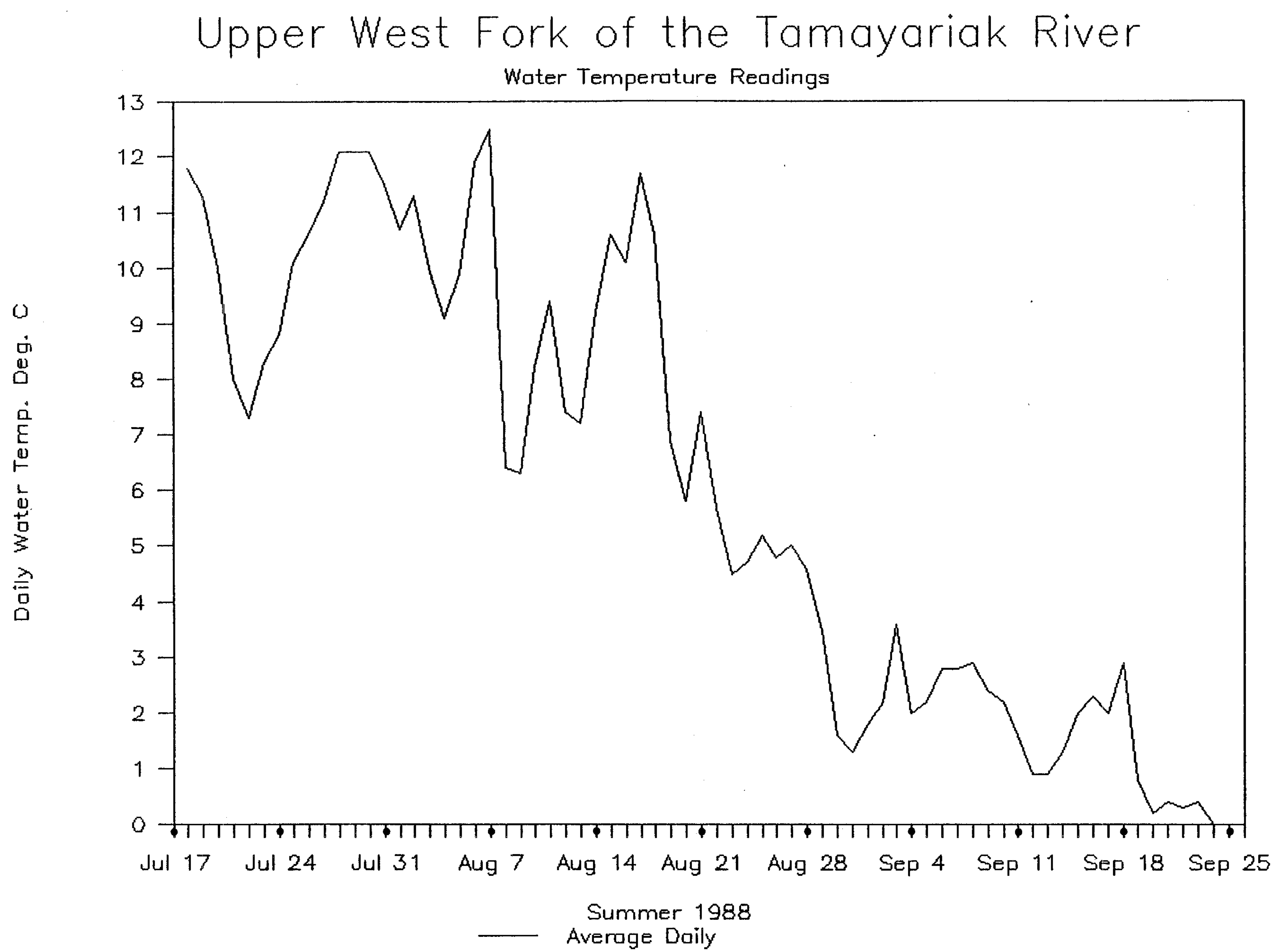
DATE	AVE.WATER TEMP DEG.C	TIME OF MAX	MAX TEMP DEG.C	TIME OF MIN	MIN TEMP DEG.C
1	10.7	1430	12	2345	9.7
2	11.3	1415	14.3	415	9.1
3	10	0	11.2	2345	8.2
4	9.1	1415	11.6	615	6.9
5	9.9	1600	13.2	500	6.5
6	11.9	1615	15	430	9.2
7	12.5	1445	14.9	2345	9.3
8	6.4	0	9.2	2345	4.9
9	6.3	1815	9.2	530	4.1
10	8.2	1715	11.7	545	4.7
11	9.4	1700	11.2	500	7.7
12	7.4	0	9.8	2345	5.4
13	7.2	1800	10.2	545	4.8
14	9.2	1630	12.2	545	6.2
15	10.6	1515	11.6	615	9.6
16	10.1	1715	11.7	600	8.7
17	11.7	1700	14.2	615	8.7
18	10.6	0	12.2	2345	8.2
19	6.9	0	8.1	2345	5.8
20	5.8	1630	7.6	645	4.4
21	7.4	1715	9.3	500	5.9
22	5.7	0	7.5	2345	4.5
23	4.5	1500	5.7	630	3.2
24	4.7	1545	6.6	600	3.3
25	5.2	1630	7.4	645	3.8
26	4.8	1845	5.9	600	3.8
27	5	1700	6.4	700	4
28	4.6	1630	6	630	3.5
29	3.5	0	4.4	2345	1.8
30	1.6	1545	3	2345	0.6
31	1.3	1600	3.1	445	0
AVERAGE	7.5		9.6		5.7
MAXIMUM	12.5		15.0		9.7
MINIMUM	1.3		3.0		0.0

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

SEPTEMBER 1988

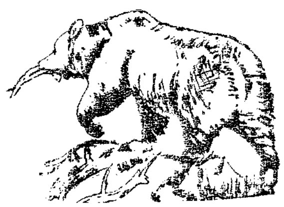
DATE	AVE.WATER TEMP DEG.C	TIME OF MAX	MAX TEMP DEG.C	TIME OF MIN	MIN TEMP DEG.C
1	1.8	1615	3.8	630	0.3
2	2.2	1630	4.9	400	0
3	3.6	1630	6.8	600	0.8
4	2	0	3.5	2345	1.5
5	2.2	1645	3.4	600	1.1
6	2.8	1800	3.6	800	2.2
7	2.8	1515	4.5	715	1.6
8	2.9	1645	6	715	0.2
9	2.4	1645	4.2	730	0.5
10	2.2	1515	4.5	715	0
11	1.6	1700	2.7	2345	0.8
12	0.9	1545	2.1	645	0.3
13	0.9	1545	2.9	300	0
14	1.3	1600	3.7	600	0
15	2	1415	4.1	400	0.1
16	2.3	1545	4.5	730	0.4
17	2	1645	4.7	445	0
18	2.9	1545	5	700	1.5
19	0.8	0	2.1	900	0.5
20	0.2	1545	0.8	2130	0
21	0.4	1615	1.4	130	0
22	0.3	1615	1.3	130	0
23	0.4	1430	1.7	2100	0
24	0	1615	0.4	1930	0
25	0	1615	0.3	1845	0
26	0	1230	0.1	1700	0
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	1.6		3.2		0.5
MAXIMUM	3.6		6.8		2.2
MINIMUM	0.0		0.1		0.0

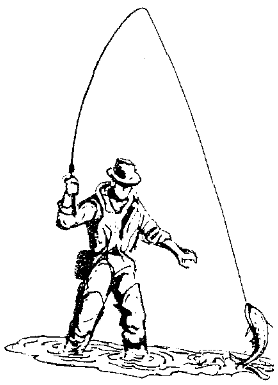

Upper West Fork of the Tamayariak River
Water Temperature Readings
Daily Water Temp. Deg. C
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Sep 18
Sep 25
Summer 1988
Average Daily

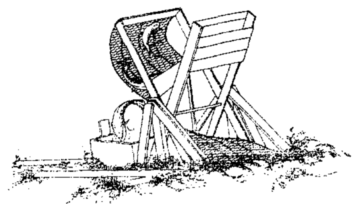
Alaska Fisheries Technical Report Number 8

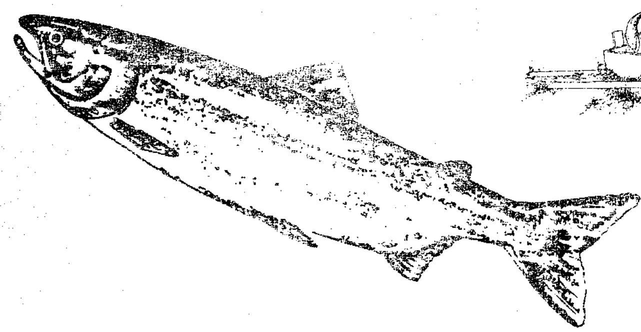
WATER RESOURCE INVENTORY AND ASSESSMENT, ARCTIC NATIONAL WILDLIFE REFUGE

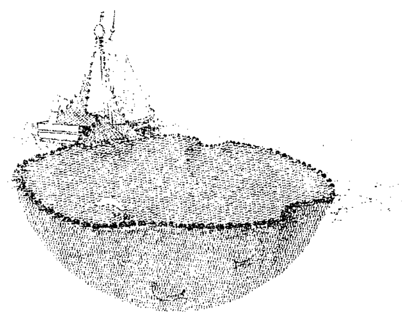
1989 Stream Discharge Gaging Data











April 1990

Region 7
U.S. Fish and Wildlife Service
Department of the Interior

WATER RESOURCE INVENTORY AND ASSESSMENT

ARCTIC NATIONAL WILDLIFE REFUGE

1989 Stream Discharge Gaging Data

Steven Lyons

Fisheries Management Services
Water Resources Branch
U.S. Fish and Wildlife Service
Department of the Interior
Anchorage, Alaska

April 1990

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STREAM DISCHARGE 1989

Introduction

This progress report is intended to provide an accounting of the accomplishments made during the second year of a multi-year water resource inventory in the coastal plain (1002 area), Arctic National Wildlife Refuge. It is also intended to extend available stream discharge and water temperature data to resource specialists for consideration in other inventory or management activities. This data represents the hydrologic conditions for one year, 1989. Additional years of data collection are required before any characterization of the hydrologic regime is appropriate.

The 1002 area of the Arctic National Wildlife Refuge is located in a remote area of Alaska adjacent to the Beaufort Sea. Because of its remoteness, logistical problems, small populace of the area, harsh climatic characteristics, and lack of competitive water uses in the past, there has been little interest by either state or federal agencies to measure water yield (Appendix A) and flood frequencies in the 1002 area. The nearest stream gaging station (US Geological Survey gage #15908000, Sagavanirktok River) is located 80 miles west of the Canning River, the western most boundary of the 1002 area. Because the Sagavanirktok River is larger than any river within the 1002 area, the data base for this river can not be extrapolated to streams and rivers in the 1002 area for water availability and flood characteristics.

Childers, et al. (1977) reported a reconnaissance level investigation of rivers, springs, aufeis fields, and lakes of the north slope, including the 1002 area. Data reported by Childers include channel characteristics, watershed basin characteristics and estimated flood characteristics of the Canning River, Marsh Creek, Sadlerochit River, Hulahula River, Jago River, and Okerokovik River. Childers also reported discharge rates and selected water quality parameters for the Katakturuk River Spring, Sadlerochit Spring, Hulahula River Spring, and Okerokovik River Spring. Six lakes were sampled for water quality and some data for ice thickness and total lake depth were reported.

The only other hydrologic data reported for the 1002 area was Lyons (1989). This report is a continuation of that study. Daum, Rost, and Smith (1984), Glesne and Deschermeier (1984), and Smith and Glesne (1982) reported selected physical and chemical characteristics of rivers and springs across the 1002 area.

The objective of this years activities was to continue a program to quantify water yield and seasonal stream discharge of watersheds making up the 1002 area of the Arctic National

Wildlife Refuge. A secondary objective was to measure surface water temperatures at stream discharge gaging sites.

Methods

The Water Resources Branch initiated a stream gaging network consisting of 8 stream gaging stations in the 1002 area in 1988. In 1989 the stream gaging network was expanded to 10 gaging sites (Figure 1) with addition of gages to the Niguanak and Sikrelurak Rivers. Stream discharge data was collected for the Tamayariak River, West Fork Itkilyariak Creek, Sadlerochit River, Sadlerochit Spring Creek, Akutoktak River, Niguanak River, and Sikrelurak River. Because the Tamayariak River is hydrologically diverse and has abundant fish and wildlife resources, four stream gages were installed on this watershed.

Parameters measured at each gaging site were water depth and water temperature. Water depth and water temperature were measured at 5 minute intervals utilizing submerged pressure transducer and temperature probes attached to a computerized field recorder. Water depth was measured to the nearest 0.01 foot (ft) and temperature to the nearest 0.1°C. The field recorder summarizes this data automatically at the end of each 24 hour period into a report and provides the 24 hour average depth, maximum depth, time of maximum depth, minimum depth, time of minimum depth, 24 hour average temperature, maximum temperature, time of maximum temperature, minimum temperature, and time of minimum temperature. This report is stored in a computer chip which can later be down-loaded onto a computer.

Throughout the data collection period, weekly visits to each site were made to collect calibration data. Calibration data were collected using standard stream discharge measurement procedures (Buchanan and Somers 1969; Lyons 1988) and included stream discharge and water surface elevation. Through regression analysis of stream depth (x) and stream discharge (y), linear and polynomial regression equations were obtained for each stream gage. Using the regression equations developed, water depth data recorded by the stream gages was converted to stream discharge.

Results

All ten stream gaging stations were installed by June 29, 1989, and most were in service until September 23, 1989. Table 1 gives the legal description of the locations for each stream gage. Polynomial regression equations were obtained for each stream gaging site, except for Niguanak River and Sadlerochit Spring Creek, (Table 2). A simple linear regression was used for

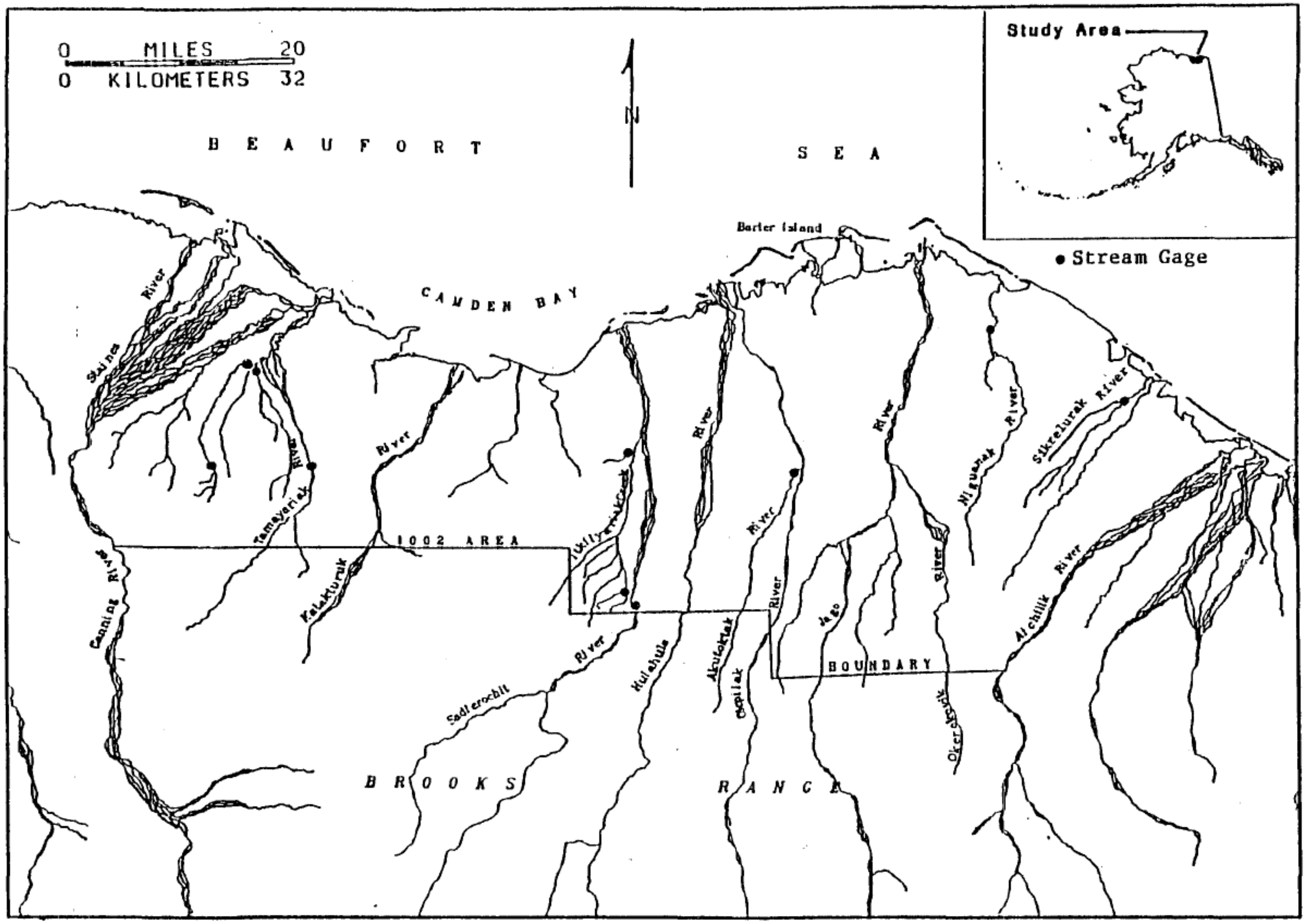

Figure 1.-The 1002 area of the Arctic National Wildlife Refuge with stream discharge gaging station locations.

Table 1.-Stream gaging station locations.

Watershed	Gage Location
Tamayariak River	SW1/4NE1/4 S.35, T6N, R26E
Lower West Fork, Tamayariak River	NW1/4NW1/4 S.12, T7N, R25E
Middle Fork, Tamayariak River	Center S.12, T7N, R25E
Upper West Fork, Tamayariak River	W1/2W1/2 S.33, T6N, R25E
West Fork, Itkilyariak Creek	NE1/4NW1/4NW1/4 S.33, T6N, R31E
Sadlerochit River	NW1/4SW1/4 S.31, T4N, R32E
Sadlerochit Spring Creek	NE1/4NW1/4 S.36, T4N, R31E
Akutoktak River	Center S.36, T6N, R33E
Niguanak River	NW1/4NW1/4NE1/4 S.36, T8N, R36E
Sikrelurak River	SE1/4SE1/4 S.36, T7N, R38E

Sadlerochit Spring Creek because it is a relatively stable spring fed stream with little variation in discharge. A better fit of the calibration data for the Niguanak River was obtained using a power curve regression. The coefficient of determination (R^2) for each regression equation ranged from 0.965 to 0.998. Utilizing these regression equations, water depth measurements recorded with stream gaging equipment were converted to stream discharge (Appendix B).

Water temperatures measured at each stream gaging site are given in Appendix C. The daily average water temperature as well as the minimum and maximum temperatures are provided.

Table 2.-Stream discharge calibration data regression equations.

Watershed	Regression Equation	R^2
Tamayariak River	$y = -129.476 + 58.158x + 107.2978x^2$	0.993
Lower West Fork, Tamayariak R.	$y = 118.052 - 183.414x + 74.145x^2$	0.988
Middle Fork, Tamayariak River	$y = 807.32 - 1152.5x + 510.07x^2 - 63.594x^3$	0.989
Upper West Fork, Tamayariak R.	$y = -10924.8 + 9265.7x - 2619.8x^2 + 247.75x^3$	0.998
West Fork, Itkilyariak Creek	$y = -106.85 + 332.29x - 360.25x^2 + 140.73x^3$	0.998
Sadlerochit River	$y = 418.12 - 611.028x + 282.6384x^2$	0.998
Sadlerochit Spring Creek	$y = -233.4441 + 194.0837x$	0.965
Akutoktak River	$y = -333.94 + 499.87x - 254.77x^2 + 44.06x^3$	0.993
Niguanak River	$y = 0.0584x^{6.17}$	0.980
Sikrelurak River	$y = 206.387 - 351.41x + 148.26x^2$	0.977

Discussion

Fiscal Year 1989 was the second year of a multi-year water resource inventory program designed to quantify stream discharge rates, discharge frequency distribution, average monthly water yields, and flood frequencies and sizes within the 1002 area of the Arctic National Wildlife Refuge. The stream discharge data from these first two years are significantly different. Precipitation during 1988 was 76 percent below average (National Oceanic and Atmospheric Administration 1988). Precipitation records for 1989 are not available. However, the snowpack accumulation during 1989 was 127 percent of average (Soil Conservation Service 1989). The higher stream discharge rates and steadily increasing spring flow rates at Sadlerochit Spring suggest that the trend toward a wetter than normal year continued throughout the summer months. Table 3 compares the average stream discharge rates per square mile of watershed drainage area for both 1988 and 1989. Average discharge ranged from 48 to 446 percent higher in 1989.

Several data gaps exist in the stream discharge and water temperature data (Appendix B and C). Problems included electrical malfunctions with the equipment and bears chewing the electric cables leading from the pressure transducer probes to the field recorders. The transducer cable at the Lower West Fork, Tamayariak River was bitten in half, presumably by a bear, on August 6, 1989. The incident was discovered two days later and the cable was reconnected to the field recorder.

The pressure transducer and anchor at the Sikrelurak River gage were pulled, probably by a bear, to the stream bank and into very shallow water on July 3, 1989. The anchor and pressure transducer were relocated back to deeper water and near the original position within the same day and only one day of data was lost.

Two other stream gaging stations, Akutoktak River and Upper West Fork, Tamayariak River, experienced electronic problems which caused significant data gaps throughout the summer season. These breakdowns are not unexpected problems and must be dealt with as they occur. The stream gaging equipment at the Akutoktak River gaging site was operational only 39 percent of the field season. The Upper West Fork, Tamayariak River stream gaging equipment was operational 68 percent of the field season.

Table 3.-Comparative analysis of stream discharge data for 1988 and 1989 in cubic feet per second per square mile (cfsm).

Watershed	Average Discharge (cfsm) 1988	Average Discharge (cfsm) 1989	Increase from 1988 (%)
Tamayariak River	1.38	2.04	48
Lower West Fork, Tamayariak River	0.77	1.24	61
Middle Fork, Tamayariak River	1.06	1.57	48
Upper West Fork, Tamayariak River	1.01	1.82	80
Itkilyariak Creek	0.88	--	--
West Fork, Itkilyariak Creek	--	2.16	--
Sadlerochit River	1.09	2.72	150
Akutoktak River	0.26	1.42	446
Niguanak River	--	1.35	--
Sikrelurak River	--	0.70	--

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APPENDIX A

Glossary of Hydrologic Terms

Glossary of Hydrologic Terms

Aufeis: An ice feature that is formed by water overflowing onto a surface, such as river ice or gravel deposits, and freezing, with subsequent layers created by water overflowing onto the ice surface itself and freezing.

Discharge rate: The rate of flow, or volume of water flowing in a given stream at a given place and within a given period of time, expressed as cubic feet per second.

Flood frequencies: The probable frequency of recurrence of a flood event, expressed as the 10-year flood, 25-year flood, 100-year flood, etc.

Water yield: The total outflow of water from a watershed, expressed in units of acre-feet or gallons.

APPENDIX B

Surface Water Discharge Records

(Listed Alphabetically)

Note:

TIME OF MAX and TIME OF MIN is military time, e.g. 0 is midnight, 40 is 0040 hours, 615 is 0615 hours, etc.

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

LOCATION.-Lat 60°49'56", long 143°46'50", in center sec.36, T.6N., R.33E., 0.6 mile upstream from confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.- 97.1 mi^2, of which 66 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 1,703 cfs Aug. 20, 1989; Minimum discharge, 2 cfs July 3, 5-7, 1989.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	187	20	212	1315	161
16	143	0	190	1600	122
17	105	0	124	2350	94
18	74	15	96	2355	58
19	52	15	58	1320	49
20	48	730	52	1645	45
21	42	0	46	2355	38
22	37	2350	44	935	32
23	45	1955	46	1240	44
24	48	1700	50	220	45
25	46	2050	49	855	45
26	42	45	49	2355	34
27	29	0	34	2355	23
28	20	0	23	2355	16
29	14	5	16	2340	12
30	10	10	12	2340	9
TOTAL	942		1,101		827
AVERAGE	59		69		52
MAXIMUM	187		212		161
MINIMUM	10		12		9
ACRE FT	1,868				

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	8	0	9	2350	7
2	6	0	7	2355	5
3	4	1255	5	1220	2
4	4	10	4	2355	3
5	3	945	3	2350	2
6	2	1300	3	2355	2
7	3	1800	4	330	2
8	4	2335	5	855	4
9	6	1225	6	0	5
10	7	2355	21	1205	5
11	23	1200	26	2335	20
12	44	630	55	0	21
13	27	5	35	2345	21
14	16	5	21	2355	12
15	10	0	12	2355	8
16	10	2355	40	1000	7
17	290	1555	678	0	40
18	344	5	549	2355	215
19	146	0	223	2355	110
20	114	1710	124	530	103
21	235	2215	694	445	117
22	469	10	670	2330	333
23	295	100	338	2135	264
24	719	250	1,643	0	268
25	444	730	529	2350	354
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
31	- - -	- - -	- - -	- - -	- - -
TOTAL	3,233		5,704		1,930
AVERAGE	129		228		77
MAXIMUM	719		1,643		354
MINIMUM	2		3		2
ACRE FT	6,413				

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	66	2355	90	1600	59
14	608	910	951	0	90
15	549	130	825	2345	370
16	392	1825	438	830	354
17	349	5	420	2355	290
18	223	0	286	2355	174
19	138	5	174	2355	114
20	251	2350	1,703	745	107
21	---	---	---	---	---
22	---	---	---	---	---
23	---	---	---	---	---
24	---	---	---	---	---
25	---	---	---	---	---
26	---	---	---	---	---
27	---	---	---	---	---
28	---	---	---	---	---
29	---	---	---	---	---
30	---	---	---	---	---
31	---	---	---	---	---
TOTAL	2,576		4,887		1,558
AVERAGE	322		611		195
MAXIMUM	608		1,703		370
MINIMUM	66		90		59
ACRE FT	5,109				

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

LOCATION.-Lat 69°50'19", Long 144°24'43", in NE1/4NW1/4NW1/4 sec.33, T.6N., R.31E., 0.6 mi. upstream from the confluence with the Itkilyariak Creek, 28 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.-26.9 mi^2, of which 8.7 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 3rd Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 1,419 cfs Aug. 20, 1989; Minimum discharge, 0 cfs July 2-6, 1989.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
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7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	61	2115	151	1045	37
16	78	5	122	855	59
17	52	0	78	1205	37
18	34	0	61	1810	26
19	34	1845	41	1115	30
20	27	2100	36	1150	22
21	24	0	32	1515	20
22	18	0	23	2355	16
23	15	5	16	1055	14
24	21	2355	51	450	15
25	27	30	57	2355	17
26	13	0	16	2355	12
27	10	0	12	2355	8
28	8	1605	8	2355	7
29	7	0	7	2310	6
30	5	5	6	2355	4
TOTAL	434		717		330
AVERAGE	27		45		21
MAXIMUM	78		151		59
MINIMUM	5		6		4
ACRE FT	861				

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	4	1430	5	2335	3
2	2	15	3	2345	0
3	0	0	0	2115	0
4	0	2025	2	815	0
5	0	0	2	1615	0
6	2	2345	5	845	0
7	7	2325	8	10	5
8	7	0	8	2355	6
9	4	5	6	2350	3
10	4	2355	12	1335	3
11	59	545	167	0	12
12	20	0	28	2355	16
13	14	0	16	2355	12
14	11	10	12	2355	10
15	8	0	10	2005	8
16	18	2350	112	0	8
17	218	730	443	15	112
18	98	50	143	2350	59
19	41	0	59	2350	32
20	31	1535	33	2355	29
21	35	2140	46	540	27
22	41	20	45	2350	36
23	33	5	36	2355	30
24	29	2350	36	1245	28
25	61	355	73	5	36
26	251	2340	515	10	56
27	320	140	554	2355	159
28	92	0	159	2345	59
29	44	5	61	2350	33
30	28	0	33	2345	24
31	23	2310	24	645	22
TOTAL	1,505		2,656		828
AVERAGE	49		86		27
MAXIMUM	320		554		159
MINIMUM	0		0		0
ACRE FT	2,985				

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	29	2120	35	0	24
2	35	2155	36	520	34
3	139	1825	478	5	36
4	251	0	401	2355	143
5	92	5	139	2355	67
6	54	0	67	2355	46
7	42	10	46	2335	38
8	35	0	38	2355	32
9	29	0	32	2345	26
10	25	5	26	1830	24
11	26	1810	27	45	24
12	26	15	27	2335	24
13	37	2330	745	950	22
14	409	30	732	1650	287
15	176	0	293	1540	143
16	184	1640	213	5	159
17	122	5	180	2325	85
18	63	5	85	2350	48
19	40	25	49	2350	34
20	300	1825	1,419	500	32
21	554	25	1,084	2355	245
22	139	0	245	2350	85
23	59	0	85	2350	45
24	37	5	45	1945	33
25	34	1020	36	2345	33
26	31	15	33	2110	29
27	30	1315	32	2355	28
28	27	15	29	1910	27
29	27	1650	27	2355	26
30	26	20	27	2150	25
31	67	1930	116	15	25
TOTAL	3,145		6,827		1,929
AVERAGE	101		220		62
MAXIMUM	554		1,419		287
MINIMUM	25		26		22
ACRE FT	6,238				

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

SEPTEMBER 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	80	0	106	2350	57
2	46	0	59	2205	44
3	45	1520	48	155	44
4	40	30	45	2325	35
5	32	0	36	2250	29
6	36	2340	51	0	29
7	56	1315	63	2355	49
8	40	0	49	2355	34
9	29	0	34	2340	27
10	25	25	27	2205	24
11	26	2355	29	5	24
12	31	2330	34	30	29
13	45	1940	54	0	33
14	48	0	52	915	44
15	40	25	48	2335	34
16	27	10	34	2355	22
17	20	0	22	745	18
18	15	5	20	750	12
19	15	1835	17	930	13
20	11	0	13	835	9
21	12	515	14	2355	9
22	9	1200	11	2335	8
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	728		866		627
AVERAGE	33		39		29
MAXIMUM	80		106		57
MINIMUM	9		11		8
ACRE FT	1,444				

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

LOCATION.-Lat 70°35", Long 143°1'54", in NW1/4NW1/4NE1/4 sec.36, T.8N., R.36E., 6 mi. upstream from the mouth, 16.5 mi. southeast of Kaktovik, Alaska.

DRAINAGE AREA.-136.2 mi^2.

REMARKS.-This is a 5th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 2,071 cfs Aug. 21, 1989; Minimum discharge, 3 cfs July 3, 1989.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
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8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	597	15	857	1620	512
15	491	2345	835	1315	395
16	550	325	1,026	1650	306
17	279	2250	565	1400	115
18	227	115	557	1715	109
19	158	225	177	920	140
20	123	2355	206	1525	60
21	187	405	301	1400	111
22	150	410	346	1825	58
23	109	515	209	1640	42
24	147	500	258	1555	78
25	137	500	288	1750	49
26	109	510	220	1710	43
27	94	350	216	1705	32
28	63	530	152	1710	20
29	53	525	115	1755	23
30	84	955	174	1835	37
TOTAL	3,558		6,502		2,130
AVERAGE	209		382		125
MAXIMUM	597		1,026		512
MINIMUM	53		115		20
ACRE FT	7,057				

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	44	525	119	1805	12
2	38	545	52	0	30
3	18	540	56	1805	3
4	44	2355	119	0	19
5	89	335	172	1330	46
6	60	455	132	1620	20
7	140	915	169	0	71
8	50	120	137	1825	14
9	30	715	69	1755	9
10	34	655	68	1710	8
11	71	610	113	1805	39
12	42	545	89	1810	17
13	27	745	58	1715	10
14	30	620	69	1635	10
15	43	540	86	1650	23
16	109	2345	166	0	47
17	82	5	166	1855	42
18	30	530	92	1750	7
19	51	2355	90	0	20
20	56	605	101	1830	23
21	79	940	99	0	51
22	67	805	94	1835	36
23	57	605	126	1615	18
24	69	620	109	1745	38
25	53	505	107	1625	16
26	145	2355	335	500	72
27	311	320	362	2355	254
28	199	15	258	2325	158
29	109	5	158	1845	57
30	94	605	193	1745	37
31	81	440	147	2345	63
TOTAL	2,352		4,111		1,270
AVERAGE	76		133		41
MAXIMUM	311		362		254
MINIMUM	18		52		3
ACRE FT	4,665				

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	61	5	63	1755	59
2	60	625	61	2035	59
3	67	2355	86	0	59
4	107	1105	117	5	86
5	94	145	107	2355	82
6	75	5	82	2350	68
7	64	115	68	2050	60
8	59	610	61	1955	57
9	55	550	58	2055	48
10	50	440	53	1730	47
11	52	2355	55	55	49
12	57	1935	60	2150	55
13	60	2355	75	15	56
14	203	2320	335	0	75
15	311	430	346	2340	275
16	266	205	279	1640	258
17	234	10	266	2335	213
18	193	25	220	2355	166
19	147	0	169	2330	130
20	320	2350	1,935	305	128
21	1,148	310	2,071	2000	520
22	413	610	752	1850	193
23	288	620	491	1800	147
24	227	715	378	1650	135
25	231	725	306	1600	174
26	166	105	242	1530	105
27	160	945	220	1730	101
28	187	655	223	1600	142
29	180	845	209	1825	150
30	203	725	220	0	187
31	246	2355	292	5	209
TOTAL	5,984		9,900		4,093
AVERAGE	193		319		132
MAXIMUM	1,148		2,071		520
MINIMUM	50		53		47
ACRE FT	11,869				

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

SEPTEMBER 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	266	500	335	1750	247
2	266	705	306	1620	284
3	573	2310	938	0	365
4	581	125	915	1940	397
5	346	600	527	1810	284
6	367	2355	432	1455	361
7	297	640	464	1725	215
8	160	730	279	1830	98
9	105	820	145	1715	83
10	115	2355	183	1540	96
11	362	2355	527	0	247
12	413	245	542	2050	357
13	395	2355	614	5	373
14	657	1220	814	1310	504
15	557	435	694	2345	452
16	341	130	425	2355	341
17	227	10	279	2305	265
18	163	145	209	2235	191
19	166	720	183	2355	159
20	119	800	132	2355	137
21	117	935	196	2125	67
22	111	1245	199	0	88
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	6,704		9,338		5,611
AVERAGE	305		424		255
MAXIMUM	657		938		504
MINIMUM	105		132		67
ACRE FT	13,297				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

LOCATION.-Lat 69°39'30", Long 144°22'52", in NW1/4SW1/4 sec.31, T.4N., R.32E., 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.-520.1 mi^2, of which 517.5 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area. Glaciers account for 2.3 percent of the drainage area or about 12 mi^2 depending on existing climatic conditions.

REMARKS.-This is a 6th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 5,733 cfs Aug. 4, 1989; Minimum discharge, 70 cfs Sept. 27, 1988.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
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12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	---	---	---	---	---
18	---	---	---	---	---
19	1,240	255	2,027	2140	856
20	923	2230	1,345	1310	749
21	1,151	2355	1,924	1530	838
22	1,582	2355	2,193	1515	1,275
23	2,056	210	2,733	1545	1,621
24	2,012	340	2,286	1345	1,756
25	3,315	535	4,977	10	2,193
26	2,613	5	3,568	1850	2,056
27	1,783	30	2,162	1635	1,556
28	1,595	230	1,797	1625	1,442
29	1,530	310	1,853	1945	1,310
30	1,369	315	1,518	1940	1,240
TOTAL	21,169		28,383		16,892
AVERAGE	1,764		2,365		1,408
MAXIMUM	3,315		4,977		2,193
MINIMUM	923		1,345		749
ACRE FT	41,988				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	1,275	325	1,442	2320	1,151
2	1,013	40	1,162	1115	856
3	775	40	875	2100	625
4	649	25	698	1100	417
5	749	2335	820	30	665
6	866	610	913	1920	811
7	923	525	962	1950	875
8	1,173	2030	1,530	0	953
9	1,275	10	1,480	2055	1,140
10	1,129	135	1,206	2055	1,044
11	1,217	2350	1,896	10	1,075
12	2,147	1215	2,431	2345	1,825
13	1,530	10	1,839	2240	1,310
14	1,275	10	1,333	2245	1,195
15	1,162	340	1,229	2205	1,096
16	1,107	2340	1,556	1840	1,003
17	2,350	2300	3,708	105	1,333
18	4,124	715	5,336	2045	3,431
19	2,698	15	3,628	2350	1,997
20	1,797	0	2,027	2130	1,661
21	1,811	1040	1,953	50	1,661
22	2,664	1800	3,470	5	1,728
23	2,579	45	3,127	2335	2,147
24	2,027	2345	2,366	1745	1,839
25	2,178	335	2,431	2005	1,924
26	2,132	315	2,480	2255	1,797
27	2,962	1510	3,749	10	1,825
28	2,546	20	3,373	2345	1,939
29	1,595	0	1,953	2345	1,310
30	1,162	5	1,321	2325	1,013
31	943	20	1,013	2335	866
TOTAL	51,833		63,307		42,512
AVERAGE	1,672		2,042		1,371
MAXIMUM	4,124		5,336		3,431
MINIMUM	649		698		417
ACRE FT	102,809				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	894	2345	943	105	856
2	1,742	1335	2,027	0	943
3	1,881	2350	2,529	1915	1,728
4	4,385	1545	5,733	0	2,563
5	3,411	45	4,653	2340	2,630
6	2,286	10	2,681	2345	2,012
7	1,853	115	2,041	2350	1,661
8	1,608	15	1,715	2335	1,480
9	1,455	240	1,530	2355	1,345
10	1,298	5	1,381	2340	1,184
11	1,151	250	1,217	2320	1,065
12	1,054	515	1,096	2355	982
13	1,003	1530	1,033	25	982
14	1,151	2350	2,698	40	993
15	3,053	420	3,769	1850	2,630
16	2,563	745	2,838	2210	2,334
17	2,193	155	2,414	2320	1,939
18	1,825	220	2,012	2245	1,608
19	1,430	5	1,661	2315	1,252
20	1,173	40	1,263	2235	1,096
21	1,997	1805	3,509	155	1,107
22	2,366	20	3,145	2350	1,769
23	1,492	30	1,825	2355	1,252
24	1,096	5	1,263	2355	962
25	885	15	982	1720	829
26	913	840	953	2245	866
27	820	15	875	2155	775
28	749	320	793	2340	673
29	657	25	681	2330	633
30	625	45	649	2345	595
31	572	0	595	2350	550
TOTAL	49,581		60,504		41,294
AVERAGE	1,599		1,952		1,332
MAXIMUM	4,385		5,733		2,630
MINIMUM	572		595		550
ACRE FT	98,342				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

SEPTEMBER 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN	MIN DISCH. CU.FT/SEC
1	904	1720	1,139	15	582
2	982	0	1,077	2345	897
3	829	0	906	2355	793
4	740	125	793	2215	721
5	673	5	721	2310	667
6	602	15	675	2305	596
7	572	2335	697	810	575
8	784	1150	870	0	690
9	649	10	760	2355	617
10	536	15	617	2340	535
11	501	2340	562	420	516
12	820	2130	1,077	35	562
13	962	100	1,057	2200	915
14	1,118	1415	1,192	45	933
15	943	5	1,108	2315	827
16	723	10	835	2345	682
17	565	20	690	1620	562
18	448	0	562	1500	444
19	359	5	492	1435	363
20	255	0	389	1800	263
21	234	320	339	2355	228
22	176	910	232	2355	193
23	158	1715	232	940	161
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	14,533		17,022		13,322
AVERAGE	632		740		579
MAXIMUM	1,118		1,192		933
MINIMUM	158		232		161
ACRE FT	28,826				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

LOCATION.-Lat 69°39'53", Long 144°24'52", in NE1/4NW1/4 sec.36, T.4N., R.31E., 3000 ft. downstream of Sadlerochit Spring, 37.5 mi. southwest of Kaktovik, Alaska.

DRAINAGE AREA.-0.5 mi^2.

REMARKS.-This a 2nd Order drainage with 2 springs contributing most of the flow.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 108 cfs Aug. 20, 1989; Minimum discharge, 28 cfs Aug. 15, 1988.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	---	---	---	---	---
18	38	1730	40	145	36
19	40	1120	44	415	36
20	38	1440	40	120	34
21	38	1330	40	300	34
22	38	1210	40	325	34
23	40	1735	48	135	36
24	42	950	46	2350	38
25	42	1240	46	305	34
26	42	1005	44	235	40
27	42	1220	44	435	38
28	42	1415	44	210	38
29	42	940	44	2335	38
30	42	1110	48	155	34
TOTAL	526		568		470
AVERAGE	40		44		36
MAXIMUM	42		48		40
MINIMUM	38		40		34
ACRE FT	1,043				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	42	905	46	250	36
2	42	1150	46	225	32
3	42	1050	46	255	34
4	42	920	46	210	34
5	40	1330	44	2325	36
6	42	545	46	25	36
7	42	655	48	15	38
8	40	330	42	1850	36
9	38	825	40	2010	36
10	44	2355	69	5	36
11	50	40	73	2345	40
12	40	405	42	2200	38
13	40	445	42	2000	38
14	40	2335	42	1810	38
15	42	2315	52	1715	38
16	48	2355	52	1135	44
17	52	325	64	2305	44
18	42	1335	44	510	40
19	44	1005	46	45	42
20	46	1530	48	110	44
21	42	30	46	2350	38
22	42	1945	52	825	34
23	50	1835	65	615	38
24	48	1850	56	850	40
25	44	1500	52	640	38
26	48	745	56	1655	42
27	38	35	44	2350	34
28	40	1540	48	705	31
29	46	1330	52	355	32
30	46	1255	52	525	36
31	46	1910	48	730	42
TOTAL	1,348		1,549		1,165
AVERAGE	43		50		38
MAXIMUM	52		73		44
MINIMUM	38		40		31
ACRE FT	2,674				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	50	1205	54	20	46
2	46	345	52	2305	42
3	54	1145	69	100	42
4	48	1150	52	615	44
5	46	1215	50	345	44
6	46	1155	50	655	42
7	46	1230	52	1235	40
8	48	1920	58	55	44
9	48	1745	54	2345	44
10	48	1330	52	110	44
11	50	1455	52	2320	46
12	52	315	58	0	48
13	56	2110	71	1215	50
14	60	0	67	2215	56
15	56	550	60	1420	54
16	60	705	64	2000	56
17	58	1105	67	2005	54
18	58	345	64	1945	54
19	58	645	62	2130	56
20	81	1345	108	15	58
21	67	10	77	2000	60
22	62	715	67	1835	58
23	62	700	67	1915	58
24	62	625	65	1835	58
25	64	705	65	2105	60
26	64	255	67	1915	62
27	67	630	73	1830	64
28	67	700	73	1750	64
29	71	635	77	1950	65
30	73	740	79	1645	69
31	81	445	85	10	77
TOTAL	1,809		2,011		1,659
AVERAGE	58		65		54
MAXIMUM	81		108		77
MINIMUM	46		50		40
ACRE FT	3,588				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

SEPTEMBER 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	81	505	83	1805	77
2	81	1035	83	1750	77
3	81	405	83	2130	77
4	79	445	85	1815	77
5	79	330	81	1430	77
6	79	2215	81	1535	77
7	79	915	83	1735	77
8	79	515	83	1650	75
9	79	840	83	1640	77
10	79	2350	87	1730	77
11	81	0	87	1445	79
12	81	900	85	1555	79
13	85	840	89	135	81
14	83	600	87	1825	81
15	81	0	85	2255	79
16	81	825	83	1610	79
17	79	0	83	1715	77
18	79	335	83	1850	77
19	79	1010	81	1710	77
20	79	1105	81	1920	75
21	79	2240	81	1605	75
22	77	230	83	1955	73
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	1,760		1,840		1,700
AVERAGE	80		84		77
MAXIMUM	85		89		81
MINIMUM	77		81		73
ACRE FT	3,491				

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

LOCATION.-Lat 69°54'43", Long 142°30'52", in SE1/4SE1/4 sec.36, T.7N., R.38E., at confluence with the West Fork Sikrelurak River, 31 mi. south-east of Kaktovik, Alaska.

DRAINAGE AREA.-74.7 mi^2.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 282 cfs Aug. 20 and 21, 1989 ; Minimum discharge, 1.0 cfs July 16, 20, and 21, 1989.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	148	5	196	2355	133
15	125	2120	166	1000	101
16	109	5	154	1045	92
17	89	2035	128	1025	68
18	62	5	107	2350	51
19	44	5	51	1245	37
20	39	2255	56	1305	30
21	42	10	56	1030	34
22	36	10	52	1105	30
23	33	2230	49	1235	24
24	34	15	47	1215	30
25	27	10	34	1205	24
26	32	2120	41	1000	26
27	26	0	37	1200	21
28	24	5	29	1035	19
29	19	0	26	1150	16
30	16	5	21	2355	13
TOTAL	905		1,250		749
AVERAGE	53		74		44
MAXIMUM	148		196		133
MINIMUM	16		21		13
ACRE FT	1,795				

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	10	5	14	1245	9
2	9	45	11	2315	6
3	- - -	- - -	- - -	- - -	- - -
4	26	1920	44	900	16
5	26	10	34	840	20
6	26	2210	36	740	21
7	25	0	34	2355	18
8	12	0	18	1155	9
9	10	2235	15	1130	8
10	11	2355	16	1145	7
11	16	1935	19	1220	13
12	9	0	16	1340	6
13	6	2300	10	955	4
14	5	0	10	1200	3
15	6	2325	8	1145	3
16	3	0	7	1255	1
17	6	2045	9	850	6
18	5	5	8	1500	4
19	4	0	7	1635	3
20	2	5	4	2100	1
21	6	2355	12	20	1
22	19	2150	22	10	12
23	20	10	22	1705	19
24	18	0	20	1355	17
25	16	0	18	2340	15
26	39	2210	74	35	15
27	72	220	76	2345	66
28	60	25	68	2355	52
29	45	0	52	2355	41
30	34	0	41	2355	29
31	26	20	29	2355	24
TOTAL	563		743		443
AVERAGE	19		25		15
MAXIMUM	72		76		66
MINIMUM	2		4		1
ACRE FT	1,117				

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	22	20	24	2350	22
2	20	25	22	2355	19
3	34	2230	68	355	18
4	62	5	66	2340	58
5	51	0	58	2335	45
6	41	5	45	2355	34
7	32	5	34	2335	27
8	26	0	27	2355	24
9	21	0	25	2325	19
10	18	20	20	2320	16
11	15	10	16	2340	13
12	13	5	14	2345	12
13	14	2355	32	1440	12
14	74	2325	94	0	33
15	92	215	94	1135	89
16	89	1810	94	845	85
17	83	0	89	2350	76
18	70	10	78	2345	62
19	56	30	64	2350	52
20	128	2345	282	300	49
21	235	100	282	2350	186
22	151	15	189	2350	122
23	99	15	125	2355	83
24	72	10	85	2130	66
25	74	835	78	20	70
26	66	10	72	2315	62
27	58	125	64	2350	52
28	51	15	54	2310	47
29	49	2315	51	1030	47
30	51	2320	52	800	47
31	60	2320	68	315	51
TOTAL	1,927		2,366		1,598
AVERAGE	62		76		52
MAXIMUM	235		282		186
MINIMUM	13		14		12
ACRE FT	3,822				

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

SEPTEMBER 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	64	150	68	2235	58
2	66	2355	97	750	56
3	154	1915	206	20	94
4	176	50	203	2335	148
5	120	0	148	2325	99
6	87	45	101	2350	76
7	70	45	78	2345	60
8	56	25	62	2340	52
9	49	0	52	2245	44
10	42	2355	49	1030	41
11	89	2040	120	0	47
12	107	25	117	2305	97
13	112	2255	145	605	94
14	151	2355	199	555	128
15	157	15	199	2245	125
16	101	115	128	2355	83
17	66	10	83	810	54
18	51	255	70	2345	33
19	36	1330	54	2345	21
20	27	1705	47	2325	12
21	18	1805	33	1225	7
22	12	1735	24	1005	6
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	1,811		2,283		1,435
AVERAGE	82		104		65
MAXIMUM	176		206		148
MINIMUM	12		24		6
ACRE FT	3,592				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

LOCATION.-Lat 69°49'58", Long 145°34', in SW1/4NE1/4 sec.35, T.6N., R.26E., 11.8 miles upstream with the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-136.1 mi^2, of which 56.8 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 5th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 1,996 cfs Aug. 12, 1988; Minimum discharge, 12 cfs Sept. 26, 1988.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	481	2355	747	1150	345
18	471	110	753	1705	359
19	431	1640	561	650	336
20	392	2200	594	1225	292
21	431	0	572	1325	373
22	341	5	431	1320	288
23	345	2355	436	905	288
24	378	230	476	1810	318
25	284	0	373	1720	242
26	254	245	292	1355	218
27	226	125	297	1440	188
28	184	145	230	1510	155
29	148	125	195	1930	121
30	114	310	145	2350	89
TOTAL	4,480		6,102		3,612
AVERAGE	320		436		258
MAXIMUM	481		753		373
MINIMUM	114		145		89
ACRE FT	8,886				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	73	5	89	2355	58
2	53	10	58	1650	47
3	56	2355	76	335	50
4	114	2345	155	0	76
5	124	40	155	1320	104
6	121	130	127	1310	111
7	141	1850	166	1220	127
8	121	100	152	2235	104
9	92	55	104	1925	82
10	95	2355	145	1140	82
11	305	700	436	0	145
12	173	0	250	2350	131
13	114	0	131	2350	104
14	89	5	104	2355	73
15	67	405	73	2330	56
16	127	2355	523	650	56
17	823	815	997	0	523
18	640	0	935	2355	431
19	350	0	436	2320	310
20	288	0	314	2335	263
21	297	2100	364	720	242
22	318	5	354	1530	297
23	354	715	387	2345	310
24	301	715	318	2350	267
25	238	0	271	2215	215
26	461	2335	759	15	215
27	651	400	791	2350	476
28	368	0	476	2350	288
29	234	0	288	2345	195
30	169	10	195	2355	148
31	145	2355	166	825	138
TOTAL	7,502		9,795		5,724
AVERAGE	242		316		185
MAXIMUM	823		997		523
MINIMUM	53		58		47
ACRE FT	14,880				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	497	2310	791	10	166
2	628	5	778	2335	534
3	481	10	545	2350	421
4	359	25	421	2315	305
5	271	0	310	2340	242
6	230	0	246	2355	215
7	207	5	215	2340	199
8	192	0	199	2355	180
9	169	20	180	2345	159
10	162	2355	199	835	152
11	297	1600	336	0	203
12	275	30	305	2345	238
13	275	2355	471	225	238
14	645	650	704	0	471
15	634	2355	772	1550	577
16	778	1210	835	2335	698
17	545	5	698	2345	426
18	354	5	431	2350	297
19	259	15	301	2355	230
20	481	2355	888	320	222
21	704	5	888	2355	523
22	411	10	528	2340	327
23	275	15	327	2355	234
24	211	10	238	1825	195
25	199	535	207	2305	188
26	180	10	192	2355	169
27	162	15	173	2300	152
28	145	5	152	2155	145
29	141	250	145	2325	138
30	138	5	141	2335	134
31	177	2145	215	205	134
TOTAL	10,482		12,831		8,512
AVERAGE	338		414		275
MAXIMUM	778		888		698
MINIMUM	138		141		134
ACRE FT	20,791				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

SEPTEMBER 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	192	5	215	2350	173
2	159	10	173	1555	152
3	148	5	155	2325	141
4	134	5	141	2345	127
5	117	10	127	2340	111
6	127	2350	184	720	108
7	246	1410	267	0	184
8	215	5	246	2350	188
9	169	5	188	2350	155
10	148	5	155	1000	145
11	301	2245	513	20	155
12	426	0	507	2015	382
13	486	1900	605	100	387
14	486	25	566	2340	406
15	336	5	411	2340	288
16	242	0	288	2320	211
17	184	10	211	2355	169
18	148	35	169	2355	138
19	111	5	138	2330	89
20	85	2220	215	815	25
21	155	2025	354	1220	61
22	177	2305	259	950	114
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	4,792		6,087		3,909
AVERAGE	218		277		178
MAXIMUM	486		605		406
MINIMUM	85		127		25
ACRE FT	9,505				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

LOCATION.-Lat 69°58'48", Long 145°47'40", in NW1/4NW1/4 sec.12, T.7N., R.25E., 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-98.1 mi^2, of which 5.5 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 647 cfs Aug. 21, 1989; Minimum discharge, 9 cfs Aug. 6-7, 1988.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	419	2215	608	1325	305
18	314	40	583	2130	212
19	287	1815	371	45	225
20	233	2345	330	1440	190
21	248	115	348	1615	193
22	172	20	265	2035	136
23	159	2355	227	1410	123
24	181	15	235	2015	142
25	119	120	161	2350	90
26	98	630	114	2310	87
27	84	330	107	2355	66
28	69	800	79	2345	61
29	55	15	61	2355	51
30	47	15	51	2255	42
TOTAL	2,485		3,540		1,923
AVERAGE	178		253		137
MAXIMUM	419		608		305
MINIMUM	47		51		42
ACRE FT	4,929				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	40	40	43	2330	38
2	36	35	39	1215	35
3	36	2300	40	1150	32
4	41	1755	47	700	36
5	41	310	44	2355	37
6	39	400	40	2035	36
7	38	1110	41	2355	32
8	30	10	32	2330	27
9	27	20	27	2310	26
10	28	2345	40	735	26
11	32	155	41	2335	26
12	26	15	27	2330	24
13	23	25	24	2340	21
14	22	1255	23	505	21
15	20	0	21	2335	19
16	25	1815	34	740	19
17	43	2340	52	0	31
18	110	1530	207	850	47
19	134	10	172	1920	119
20	129	500	136	2335	117
21	108	15	121	1705	100
22	110	805	117	2350	101
23	98	45	107	2320	88
24	76	35	90	2305	65
25	59	0	66	2300	51
26	121	2355	374	5	54
27	345	330	415	2340	248
28	181	10	265	2355	132
29	101	45	132	2350	78
30	64	5	79	2355	51
31	47	25	51	2020	46
TOTAL	2,230		2,947		1,783
AVERAGE	72		95		58
MAXIMUM	345		415		248
MINIMUM	20		21		19
ACRE FT	4,423				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	198	2025	466	20	49
2	391	30	447	2215	361
3	308	40	378	2350	248
4	205	10	265	2325	163
5	136	115	170	2345	119
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	75	130	82	2325	66
10	62	45	69	1750	57
11	90	2230	134	200	60
12	125	205	136	1910	114
13	134	2210	172	425	107
14	287	1550	374	20	159
15	238	10	308	1600	200
16	285	1900	348	25	220
17	235	10	320	2350	181
18	144	15	186	2350	114
19	96	10	119	2350	79
20	183	2355	630	225	76
21	477	225	647	2340	308
22	217	0	317	2355	157
23	123	5	159	2350	95
24	79	40	96	2340	66
25	61	30	66	2330	57
26	57	10	59	2335	54
27	52	225	56	2335	48
28	47	120	49	2240	43
29	44	1900	46	915	42
30	47	1635	48	250	44
31	72	2355	95	150	46
TOTAL	4,468		6,242		3,333
AVERAGE	160		223		119
MAXIMUM	477		647		361
MINIMUM	44		46		42
ACRE FT	8,862				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	9.0	1730	12.1	510	6.2
2	9.3	1750	12.3	620	6.4
3	11.6	1700	15.5	520	7.5
4	13.6	1800	16.0	535	11.0
5	13.4	1715	15.6	525	11.3
6	14.2	1835	16.7	555	12.1
7	12.5	0	14.2	2355	11.3
8	12.2	1710	14.6	505	10.1
9	13.7	1535	16.7	535	10.6
10	14.6	1540	17.7	625	12.9
11	13.4	1910	15.6	605	11.7
12	14.1	1940	16.5	520	11.5
13	15.9	1700	18.4	625	13.6
14	16.4	1545	19.0	620	14.1
15	16.5	1535	18.9	615	14.1
16	13.6	0	16.5	2355	10.9
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
31	- - -	- - -	- - -	- - -	- - -
TOTAL	214.0		256.3		175.3
AVERAGE	13.4		16.0		11.0
MAXIMUM	16.5		19.0		14.1
MINIMUM	9.0		12.1		6.2

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	12.3	0	13.9	2355	11.1
14	9.9	0	11.1	2355	8.6
15	8.1	1535	8.7	520	7.6
16	7.0	1535	7.7	2355	5.7
17	6.6	1725	9.1	700	4.4
18	9.3	1830	12.2	540	6.1
19	11.6	1705	14.9	640	9.4
20	9.5	0	12.1	2355	7.2
21	8.5	1725	11.1	615	6.2
22	9.2	1625	12.1	620	6.4
23	9.8	1625	13.0	635	6.7
24	10.0	1640	12.0	540	7.6
25	9.4	0	10.2	2355	8.6
26	10.2	1705	13.0	255	8.0
27	10.9	1620	13.4	720	9.2
28	8.9	0	10.1	2355	7.9
29	8.2	1740	9.5	615	7.1
30	7.6	1440	8.2	2355	6.7
31	7.4	1800	9.1	625	5.9
TOTAL	174.4		211.4		140.4
AVERAGE	9.2		11.1		7.4
MAXIMUM	12.3		14.9		11.1
MINIMUM	6.6		7.7		4.4

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

SEPTEMBER 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	6.9	1605	9.0	740	4.9
2	5.2	0	6.4	920	4.8
3	5.5	1725	6.7	530	4.6
4	7.0	1725	10.0	625	4.6
5	8.5	1600	10.7	700	6.6
6	7.8	0	8.4	2355	6.1
7	6.5	1640	9.4	715	4.0
8	6.7	1715	9.2	620	4.1
9	8.8	1630	10.5	710	7.0
10	9.6	1655	11.2	555	8.4
11	7.9	0	8.9	2355	6.8
12	6.6	1550	7.7	840	5.6
13	5.0	0	6.2	2355	3.3
14	2.1	0	3.3	2355	1.2
15	1.4	1550	2.6	750	0.6
16	1.1	1515	2.1	715	0.3
17	1.0	1600	2.4	625	0.0
18	0.6	1545	1.8	345	0.0
19	0.4	1605	1.6	2100	0.0
20	0.0	1220	0.0	1740	0.0
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	98.6		128.1		72.9
AVERAGE	4.9		6.4		3.6
MAXIMUM	9.6		11.2		8.4
MINIMUM	0.0		0.0		0.0

APPENDIX D

Addendum, 1988 Stream Discharge Data for Sadlerochit Spring Creek

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

LOCATION.-Lat 69°39'53", Long 144°24'52", in NE1/4NW1/4 sec.36, T.4N., R.31E., 3000 ft. downstream of Sadlerochit Spring, 37.5 mi. southwest of Kaktovik, Alaska.

DRAINAGE AREA.-0.5 mi^2.

REMARKS.-This a 2nd Order drainage with 2 springs contributing most of the flow.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 55 cfs Aug. 16 & 19, 1988; Minimum discharge, 28 cfs Aug. 15, 1988.

JULY 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	---	---	---	---	---
18	---	---	---	---	---
19	---	---	---	---	---
20	---	---	---	---	---
21	---	---	---	---	---
22	38	1500	38	1030	37
23	38	1115	40	1530	36
24	38	845	40	2315	37
25	38	1345	40	1845	37
26	38	1815	40	1930	37
27	38	845	40	1730	37
28	37	1330	38	1500	36
29	37	945	38	1615	35
30	36	1045	37	1515	35
31	37	1445	38	1645	36
TOTAL	379		389		367
AVERAGE	38		39		37
MAXIMUM	38		40		37
MINIMUM	36		37		35
ACRE FT	753				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

AUGUST 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	37	1200	38	1545	36
2	38	1145	40	1800	37
3	38	1130	40	1345	37
4	38	930	41	1500	35
5	38	1100	41	1715	36
6	38	1230	41	915	37
7	38	900	40	2045	37
8	38	1200	40	1630	37
9	40	1130	43	2045	38
10	43	815	45	600	42
11	41	1215	43	1815	40
12	40	1100	42	1800	38
13	41	1300	42	1430	40
14	38	1130	42	2030	34
15	40	1200	48	1815	28
16	41	1300	55	1430	30
17	41	1045	51	1515	35
18	42	1430	53	1815	33
19	43	1115	55	1745	30
20	41	1115	50	1815	35
21	41	1430	51	1615	32
22	42	1115	53	1500	33
23	44	915	48	1300	41
24	44	1230	46	500	41
25	44	1800	45	2230	41
26	43	1145	44	2000	42
27	43	945	43	2130	42
28	43	1015	44	2100	42
29	43	900	44	1800	42
30	43	1215	44	1600	42
31	44	915	45	1915	43
TOTAL	1,264		1,391		1,157
AVERAGE	41		45		37
MAXIMUM	44		55		43
MINIMUM	37		38		28
ACRE FT	2,507				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

SEPTEMBER 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	44	1500	48	1845	43
2	44	1200	50	1345	43
3	44	1115	45	1730	43
4	43	815	44	1430	42
5	43	900	44	1630	42
6	45	2215	48	115	43
7	46	1400	48	1600	45
8	45	1130	46	2100	44
9	44	930	46	2015	43
10	44	945	46	1600	41
11	43	1000	45	1900	42
12	44	930	46	2015	43
13	44	945	46	2345	43
14	44	1015	45	1645	43
15	44	1115	45	1600	43
16	44	1100	45	1945	43
17	44	1045	45	2115	43
18	44	915	45	1715	42
19	43	945	44	1530	42
20	43	1300	44	1430	42
21	43	1400	44	515	43
22	44	945	44	630	43
23	43	1200	44	1845	42
24	42	1115	43	1900	41
25	42	1045	43	2115	41
26	43	1000	44	1945	42
27	42	1130	43	1845	41
28	42	1130	43	1645	42
29	42	1215	43	1600	41
30	42	1100	43	645	41
TOTAL	1,295		1,342		1,261
AVERAGE	43		45		42
MAXIMUM	46		50		45
MINIMUM	42		43		41
ACRE FT	2,568				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

OCTOBER 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	42	1115	44	1800	41
2	42	315	43	1715	41
3	41	1030	42	2030	41
4	41	900	42	330	41
5	41	1215	42	1600	41
6	42	845	42	2200	41
7	41	1000	42	1230	40
8	41	1200	42	230	40
9	41	315	42	1900	40
10	41	1315	42	1915	38
11	40	1030	41	2015	38
12	41	1830	41	2015	40
13	41	715	41	1115	40
14	41	930	42	445	41
15	41	145	42	1715	40
16	41	1045	42	1700	40
17	41	315	42	530	40
18	42	1445	43	45	41
19	41	1315	43	2145	40
20	40	1130	41	245	38
21	41	700	42	845	40
22	41	1245	42	630	40
23	41	2230	42	200	41
24	41	1100	41	330	40
25	40	1200	41	1815	38
26	38	1145	40	2115	37
27	40	1500	41	1830	38
28	40	2315	41	130	40
29	41	1215	41	0	38
30	40	2200	41	715	38
31	40	0	41	200	40
TOTAL	1,252		1,282		1,225
AVERAGE	40		41		40
MAXIMUM	42		44		41
MINIMUM	38		40		37
ACRE FT	2,484				

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

NOVEMBER 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	40	1300	41	2200	40
2	40	2315	42	1545	38
3	38	1230	40	230	37
4	38	1045	40	2330	37
5	38	1530	40	2045	38
6	38	1330	40	900	37
7	38	1245	40	1615	37
8	38	200	38	2045	37
9	38	1345	38	45	37
10	38	1045	40	715	37
11	38	2330	40	615	37
12	38	700	40	2345	37
13	38	2315	40	330	38
14	38	100	40	2230	38
15	38	1930	40	200	38
16	40	2245	41	230	38
17	40	115	41	2345	38
18	38	315	40	1015	37
19	38	2130	40	545	37
20	38	1845	40	1715	37
21	38	845	41	600	38
22	40	745	40	1815	38
23	38	800	40	30	38
24	38	1930	40	615	37
25	38	715	40	2115	37
26	38	1245	40	315	37
27	38	1645	38	0	37
28	38	2145	40	445	37
29	38	330	40	1245	37
30	38	45	40	545	37
TOTAL	1,159		1,189		1,135
AVERAGE	39		40		38
MAXIMUM	40		42		40
MINIMUM	38		38		37
ACRE FT	2,300		2,358		

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

DECEMBER 1988

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	38	2200	40	2330	37
2	38	1815	40	430	37
3	38	2230	38	445	37
4	37	2315	38	1000	36
5	38	830	40	1630	37
6	38	15	40	2215	36
7	37	615	38	330	35
8	36	2315	37	930	35
9	36	2200	38	1345	35
10	38	45	38	2115	37
11	37	1000	38	2330	37
12	37	1800	40	415	36
13	38	130	40	2330	37
14	36	1245	37	2030	35
15	35	2145	36	1700	34
16	36	515	37	1915	35
17	35	730	36	400	35
18	35	1100	37	1845	34
19	35	1945	36	2215	34
20	35	1245	36	245	34
21	36	1045	36	1945	35
22	36	2345	37	1645	35
23	35	15	37	2230	34
24	35	1600	36	815	34
25	35	600	36	1700	34
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
31	- - -	- - -	- - -	- - -	- - -
TOTAL	920		947		894
AVERAGE	37		38		36
MAXIMUM	38		40		37
MINIMUM	35		36		34
ACRE FT	1,824				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

SEPTEMBER 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	105	1655	116	2350	90
2	85	130	93	2220	76
3	82	1955	88	245	76
4	78	40	87	2340	66
5	61	5	69	2345	51
6	49	20	52	2255	47
7	57	2310	72	300	47
8	66	155	72	2305	59
9	54	100	61	2335	47
10	48	2350	62	950	43
11	121	2355	265	0	61
12	235	135	285	2315	193
13	217	2300	296	440	186
14	270	430	302	2330	246
15	205	25	251	2355	168
16	134	40	170	2355	107
17	87	10	110	2330	69
18	59	5	71	2330	48
19	43	5	48	2355	37
20	38	1045	76	2325	23
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	2,094		2,646		1,740
AVERAGE	105		132		87
MAXIMUM	270		302		246
MINIMUM	38		48		23
ACRE FT	4,153				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

LOCATION.-Lat 69°49'58", Long 145°34', in SW1/4NE1/4 sec.35, T.6N., R.26E., 11.8 miles upstream with the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-136.1 mi^2, of which 56.8 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 5th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature, 19.7°C July 15, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	5.2	1455	9.0	540	2.4
18	4.4	1950	8.4	625	1.3
19	5.4	0	6.8	2355	4.5
20	8.1	1905	13.5	510	3.7
21	8.7	1540	11.4	750	6.7
22	8.2	1850	11.3	725	5.3
23	10.1	1800	13.7	545	6.6
24	10.2	1920	12.0	740	7.8
25	9.3	1915	12.1	1005	6.9
26	11.2	1730	15.5	635	7.6
27	11.6	1805	14.9	600	8.7
28	12.3	1740	15.4	605	9.3
29	11.6	1800	13.6	620	9.6
30	9.8	0	12.3	1110	8.1
TOTAL	126.1		169.9		88.5
AVERAGE	9.0		12.1		6.3
MAXIMUM	12.3		15.5		9.6
MINIMUM	4.4		6.8		1.3

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	8.8	1815	12.3	655	5.8
2	9.5	1855	13.0	610	6.3
3	12.2	1710	16.6	535	7.7
4	14.5	1815	17.1	550	11.5
5	14.5	1710	16.8	605	12.2
6	15.3	1820	17.4	645	13.1
7	13.1	0	15.6	2355	11.4
8	12.7	1720	15.9	520	9.9
9	14.4	1730	17.9	550	11.0
10	15.2	1535	18.6	630	13.2
11	13.2	1855	15.3	855	11.2
12	14.4	1925	17.7	605	11.5
13	15.9	1845	18.7	630	13.5
14	16.5	1610	19.4	615	14.1
15	16.6	1825	19.7	605	14.1
16	13.1	0	16.6	2355	9.8
17	8.9	1955	10.4	805	7.2
18	10.8	1825	15.1	605	6.6
19	12.0	0	13.3	2355	11.1
20	11.3	1740	14.6	635	9.1
21	9.5	0	11.4	920	7.8
22	10.6	1940	14.0	555	7.8
23	12.8	1845	16.2	630	9.5
24	12.7	1610	15.1	655	10.2
25	12.4	1515	14.5	655	10.4
26	9.1	0	11.4	2355	7.8
27	8.2	1945	10.9	630	5.8
28	10.4	1830	14.8	645	6.1
29	13.0	1840	16.9	620	9.3
30	13.5	1800	16.8	740	10.4
31	13.1	1920	14.4	720	11.9
TOTAL	388.2		478.4		307.3
AVERAGE	12.5		15.4		9.9
MAXIMUM	16.6		19.7		14.1
MINIMUM	8.2		10.4		5.8

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	13.9	1620	16.0	835	12.1
2	11.6	0	13.3	935	10.1
3	11.2	2005	13.5	820	9.4
4	12.9	1855	17.4	640	9.0
5	15.4	1815	18.2	700	12.9
6	16.0	1850	18.9	735	13.5
7	16.0	1730	19.3	725	12.9
8	16.1	1835	19.5	655	12.9
9	16.0	1835	18.5	720	13.2
10	15.4	1505	17.4	830	13.8
11	14.3	1705	16.5	740	12.0
12	15.3	1705	18.8	725	12.5
13	12.5	0	15.1	720	11.3
14	10.2	0	11.3	2355	9.0
15	8.3	0	9.0	740	7.6
16	7.2	1730	7.9	2355	6.3
17	7.3	2045	10.4	715	4.6
18	9.8	2025	13.1	745	6.4
19	11.5	1930	14.3	800	9.6
20	9.6	0	12.6	2355	7.4
21	8.4	1810	11.4	730	6.0
22	8.9	1815	12.3	725	5.8
23	9.5	1830	12.8	750	6.2
24	9.6	1755	11.6	730	7.3
25	9.5	1740	10.7	905	8.6
26	10.1	1955	13.1	605	8.1
27	11.5	1745	13.8	835	9.5
28	9.7	0	11.0	2355	9.0
29	8.8	1855	10.0	845	7.6
30	8.0	0	9.1	2355	7.2
31	7.4	1825	9.1	805	6.0
TOTAL	351.9		425.9		287.8
AVERAGE	11.4		13.7		9.3
MAXIMUM	16.1		19.5		13.8
MINIMUM	7.2		7.9		4.6

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

SEPTEMBER 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	7.2	1725	9.2	920	4.9
2	5.9	0	7.4	1040	5.3
3	6.2	1845	7.3	725	5.4
4	7.1	1940	9.8	745	4.9
5	8.8	1735	10.9	810	6.9
6	8.0	0	9.2	2355	6.8
7	6.8	1820	9.5	820	4.2
8	6.6	1910	9.1	820	3.9
9	8.9	1840	10.8	810	7.2
10	9.5	1800	11.1	825	8.3
11	8.0	0	9.3	2355	7.0
12	6.7	1930	7.8	840	5.5
13	5.2	0	6.8	2355	3.8
14	2.4	0	3.8	2355	1.8
15	1.9	1750	2.9	850	1.0
16	1.5	1720	2.3	735	0.6
17	1.3	1745	2.5	745	0.2
18	0.8	1710	1.7	505	0.1
19	0.7	1720	1.9	2210	0.1
20	0.1	1430	0.2	1820	0.1
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	103.6		133.5		78.0
AVERAGE	5.2		6.7		3.9
MAXIMUM	9.5		11.1		8.3
MINIMUM	0.1		0.2		0.1

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

LOCATION.-Lat 69°58'48", Long 145°47'40", in NW1/4NW1/4 sec.12, T.7N., R.25E., 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-98.1 mi^2, of which 5.5 mi^2 in located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature, 16.6°C July 15, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	5.3	1425	9.4	535	2.4
18	4.7	1735	8.0	600	1.8
19	5.0	0	5.7	2355	4.1
20	6.8	1830	11.7	545	2.5
21	8.3	1510	10.2	2355	6.7
22	6.4	1725	8.7	710	4.6
23	7.5	1810	10.9	615	4.4
24	9.3	1540	11.5	730	7.4
25	8.2	1730	10.7	730	6.4
26	7.9	1755	10.6	600	5.5
27	8.4	1735	11.4	515	5.7
28	9.3	1715	12.2	520	6.5
29	8.8	1725	11.0	550	6.9
30	7.9	1650	9.9	835	6.1
TOTAL	103.8		141.9		71.0
AVERAGE	7.4		10.1		5.1
MAXIMUM	9.3		12.2		7.4
MINIMUM	4.7		5.7		1.8

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	7.5	1720	10.5	605	5.1
2	7.6	1735	10.5	540	5.0
3	9.2	1620	12.7	505	5.7
4	11.7	1425	14.4	420	8.5
5	12.2	1705	14.9	455	9.9
6	13.1	1755	15.4	445	11.0
7	11.0	0	13.0	2355	9.3
8	9.8	1635	12.1	540	8.0
9	11.2	1555	14.3	535	8.3
10	12.1	1600	15.4	610	9.8
11	11.6	1755	13.4	615	10.0
12	12.0	1645	15.4	525	9.3
13	13.2	1625	16.0	430	11.0
14	13.2	1550	15.9	600	11.0
15	13.7	1625	16.6	515	11.2
16	10.8	0	13.1	2355	9.0
17	9.7	1855	11.5	600	8.3
18	10.8	1655	13.5	435	7.8
19	10.5	1700	12.4	2355	9.2
20	9.3	1700	12.0	645	7.7
21	7.4	0	8.5	2355	6.6
22	7.9	1840	10.4	445	5.8
23	9.8	1620	13.2	530	6.7
24	10.6	1735	13.3	510	8.2
25	10.4	1345	12.7	655	8.8
26	8.3	0	9.2	2355	7.3
27	8.1	1815	10.1	550	6.4
28	9.4	1730	12.9	600	6.2
29	10.4	1650	13.5	605	7.8
30	9.8	1710	12.2	610	7.9
31	8.9	1825	9.8	555	8.2
TOTAL	321.2		398.8		255.0
AVERAGE	10.4		12.9		8.2
MAXIMUM	13.7		16.6		11.2
MINIMUM	7.4		8.5		5.0

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	10.6	1615	13.9	835	8.2
2	10.1	1820	11.1	730	9.2
3	9.9	1815	12.1	805	8.6
4	11.1	1805	14.5	555	7.9
5	12.8	1820	15.0	630	11.3
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	12.6	1445	14.9	635	10.3
10	12.5	1620	14.5	2355	11.3
11	11.8	1720	13.8	800	10.2
12	12.7	1710	15.6	700	10.5
13	10.9	1330	12.1	610	9.8
14	9.9	1625	10.9	2355	9.2
15	8.8	1615	9.5	2355	8.2
16	7.9	1735	8.9	2355	6.7
17	6.2	1835	6.9	755	5.2
18	7.9	1630	10.1	620	6.0
19	8.8	1845	11.4	555	7.1
20	8.3	0	9.3	2355	7.6
21	8.7	1745	11.1	650	6.9
22	8.8	1635	11.4	640	6.5
23	8.7	1630	11.3	700	6.6
24	8.7	1630	10.8	620	6.6
25	8.2	1410	9.5	2355	7.0
26	8.1	1755	10.5	535	6.7
27	8.8	1655	11.0	655	7.3
28	6.7	0	7.6	2355	6.0
29	6.3	1600	7.2	505	5.6
30	5.9	1455	6.6	2355	5.4
31	5.8	1605	6.8	720	4.9
TOTAL	257.5		308.3		216.8
AVERAGE	9.2		11.0		7.7
MAXIMUM	12.8		15.6		11.3
MINIMUM	5.8		6.6		4.9

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

SEPTEMBER 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	6.0	1615	7.7	745	4.9
2	4.4	0	5.1	735	4.0
3	4.7	1710	5.7	440	4.0
4	5.5	1700	7.6	655	4.2
5	6.2	1535	8.3	740	4.8
6	6.0	1445	7.0	630	5.0
7	5.8	1625	8.0	800	4.3
8	5.4	1740	7.3	710	3.6
9	6.7	1705	8.3	725	5.5
10	7.3	1515	9.1	40	6.4
11	6.2	1630	6.7	2355	5.8
12	5.9	1550	6.7	745	5.3
13	5.4	1455	5.9	2355	4.5
14	3.6	0	4.4	2355	3.1
15	2.7	0	3.1	2355	2.4
16	2.1	1620	2.6	2245	1.6
17	2.1	1600	3.2	745	1.5
18	1.5	1525	2.1	330	0.9
19	1.3	1605	2.2	2355	0.2
20	0.3	1550	1.4	210	-0.1
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	89.1		112.4		71.9
AVERAGE	4.5		5.6		3.6
MAXIMUM	7.3		9.1		6.4
MINIMUM	0.3		1.4		-0.1

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

LOCATION.-Lat 69°58'33", Long 145°46'44", in center sec.12, T.7N., R.25E., 0.4 mile upstream from the confluence with the West Fork, Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-61.3 mi^2, of which 0.8 mi^2 is located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature, 17.9°C July 15, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX MAXT	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	---	---	---	---	---
18	---	---	---	---	---
19	---	---	---	---	---
20	---	---	---	---	---
21	---	---	---	---	---
22	---	---	---	---	---
23	---	---	---	---	---
24	---	---	---	---	---
25	---	---	---	---	---
26	---	---	---	---	---
27	---	---	---	---	---
28	---	---	---	---	---
29	9.1	1746	11.3	646	6.9
30	8.2	1836	10.3	946	6.2
TOTAL	17.3		21.6		13.1
AVERAGE	8.7		10.8		6.6
MAXIMUM	9.1		11.3		6.9
MINIMUM	8.2		10.3		6.2

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	8.0	1756	11.3	641	5.3
2	8.3	1851	11.4	626	5.5
3	10.3	1706	14.2	601	6.4
4	13.0	1736	15.9	526	9.9
5	13.1	1711	15.6	546	10.6
6	13.7	1931	16.1	601	11.4
7	11.2	1	14.1	2356	9.3
8	9.9	1636	12.3	701	7.7
9	11.9	1806	15.6	551	8.5
10	13.4	1611	16.8	621	10.8
11	12.4	1826	14.4	631	10.7
12	13.0	1731	16.2	541	10.2
13	14.5	1651	17.5	641	12.1
14	14.6	1621	17.3	626	12.2
15	15.0	1726	17.9	606	12.4
16	11.7	1	15.2	2356	9.6
17	9.6	1831	10.8	901	8.5
18	11.3	1846	14.7	606	8.0
19	11.8	1711	13.4	2356	10.7
20	10.4	1726	12.9	716	8.6
21	8.2	1	9.9	921	7.3
22	8.7	1921	11.7	631	6.3
23	11.2	1606	14.7	616	7.8
24	11.9	1836	14.6	651	9.7
25	11.4	1441	13.7	711	9.6
26	8.7	1	10.3	2356	8.0
27	8.3	1931	10.4	701	6.3
28	10.1	1811	13.9	656	6.6
29	11.4	1751	14.6	646	8.6
30	10.8	1801	13.3	821	8.6
31	9.7	1	10.8	756	8.8
TOTAL	347.5		431.5		276.0
AVERAGE	11.2		13.9		8.9
MAXIMUM	15.0		17.9		12.4
MINIMUM	8.0		9.9		5.3

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	11.8	1821	15.5	736	8.9
2	11.0	1	13.1	1006	9.9
3	10.2	1926	12.3	921	8.8
4	11.6	1846	15.4	646	8.2
5	14.0	1826	16.3	646	12.1
6	14.2	1836	16.6	726	12.0
7	13.3	1706	15.5	711	11.3
8	13.1	1821	16.6	716	10.1
9	13.5	1851	15.9	726	10.8
10	13.3	1636	15.3	731	11.9
11	12.3	1841	14.3	616	10.2
12	13.9	1711	17.0	721	11.6
13	11.7	1	13.7	711	10.4
14	10.1	1636	11.0	2356	9.4
15	8.6	1	9.3	746	8.0
16	7.6	1811	8.7	2356	6.7
17	5.8	1956	6.9	831	4.6
18	8.0	1751	10.5	701	5.9
19	9.2	1921	12.0	751	7.3
20	8.6	1	10.3	2356	7.6
21	8.4	1831	11.1	726	6.3
22	8.8	1746	11.5	731	6.4
23	8.8	1731	11.5	736	6.3
24	8.8	1751	10.8	706	6.4
25	8.5	1531	9.7	2356	7.5
26	8.3	1916	10.8	716	6.6
27	9.3	1741	11.8	826	7.5
28	7.0	1	8.7	2356	6.1
29	6.3	1756	7.2	731	5.5
30	5.9	1506	6.4	841	5.4
31	5.8	1911	6.9	756	4.7
TOTAL	307.7		372.6		254.4
AVERAGE	9.9		12.0		8.2
MAXIMUM	14.2		17.0		12.1
MINIMUM	5.8		6.4		4.6

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

LOCATION.-Lat 69°58'33", Long 145°46'44", in center sec.12, T.7N., R.25E., 0.4 mile upstream from the confluence with the West Fork, Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-61.3 mi^2, of which 0.8 mi^2 is located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 617.5 cfs Sept. 5, 1988; Minimum discharge, 1.2 cfs Aug. 6-7, 1988.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	---	---	---	---	---
18	---	---	---	---	---
19	---	---	---	---	---
20	---	---	---	---	---
21	---	---	---	---	---
22	---	---	---	---	---
23	---	---	---	---	---
24	---	---	---	---	---
25	---	---	---	---	---
26	---	---	---	---	---
27	---	---	---	---	---
28	---	---	---	---	---
29	34	21	46	1551	29
30	26	26	30	1806	24
TOTAL	60		76		53
AVERAGE	30		38		27
MAXIMUM	34		46		29
MINIMUM	26		30		24
ACRE FT	119				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	20	1	25	1736	18
2	19	411	22	516	17
3	20	2346	23	1746	16
4	29	2056	40	606	23
5	36	326	42	1226	30
6	36	2356	46	1431	33
7	34	36	46	2346	26
8	21	11	26	1731	17
9	18	2356	23	1141	16
10	23	2256	36	1446	18
11	27	6	36	1621	23
12	19	26	26	1916	16
13	18	441	20	1626	15
14	17	141	20	1711	15
15	14	111	17	1621	12
16	15	2351	18	911	13
17	124	2301	233	26	18
18	196	26	231	2356	143
19	118	1	143	1236	110
20	106	1	114	2356	96
21	98	2321	122	821	83
22	114	21	122	1621	108
23	104	2326	131	1731	92
24	108	31	131	2351	90
25	76	1	90	2331	65
26	198	2326	287	1	65
27	255	111	287	2356	196
28	141	6	194	2356	100
29	77	1	100	2356	60
30	48	1	60	2356	40
31	39	301	45	1016	38
TOTAL	2,168		2,756		1,612
AVERAGE	70		89		52
MAXIMUM	255		287		196
MINIMUM	14		17		12
ACRE FT	4,300				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	242	1401	301	1	45
2	255	11	286	2351	235
3	212	1	235	2341	187
4	162	11	189	2341	135
5	108	1	135	2356	89
6	77	6	89	2351	70
7	70	206	76	701	65
8	70	21	74	711	63
9	60	31	70	2341	55
10	52	401	60	1816	51
11	160	1551	200	6	55
12	152	6	181	2356	120
13	116	2356	145	1636	112
14	214	1356	233	1	147
15	179	16	204	1526	169
16	214	1706	244	341	169
17	175	1	225	2356	137
18	112	1	139	2346	92
19	81	21	98	2221	72
20	220	2031	298	306	63
21	282	6	303	2356	214
22	158	1	212	2351	118
23	90	6	116	2356	72
24	62	6	72	2351	55
25	52	1	55	2356	49
26	51	1731	52	941	49
27	48	6	51	2351	45
28	43	1	45	1106	42
29	48	2316	51	1	43
30	51	2051	52	101	51
31	112	1831	169	226	52
TOTAL	3,928		4,660		2,921
AVERAGE	127		150		94
MAXIMUM	282		303		235
MINIMUM	43		45		42
ACRE FT	7,791				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

SEPTEMBER 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	124	6	156	2356	98
2	85	6	96	1606	81
3	98	1441	102	16	87
4	81	11	96	2356	70
5	60	1	70	2356	52
6	51	2341	55	706	48
7	62	1756	65	16	55
8	57	21	63	2341	52
9	49	31	54	2331	46
10	48	2356	63	756	43
11	143	1826	181	1	65
12	162	1	179	2311	150
13	171	2246	200	531	147
14	214	2356	242	346	198
15	198	41	242	2356	156
16	118	1	158	2351	90
17	70	16	92	2351	60
18	48	1	60	2336	40
19	33	1	40	2356	28
20	45	1031	98	2026	23
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	1,917		2,312		1,589
AVERAGE	96		116		79
MAXIMUM	214		242		198
MINIMUM	33		40		23
ACRE FT	3,802				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

LOCATION.-Lat 69°49'54", Long 145°55'20", in center W1/2W1/2 sec.33, T.6N., R.25E., 13.9 miles upstream with the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-49.2 mi^2, of which 5.6 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum discharge, 1,478 cfs Aug. 20, 1989; Minimum discharge, 0 cfs July 9, 10, and 13, 1989.

JUNE 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	---	---	---	---	---
18	---	---	---	---	---
19	327	1220	565	520	206
20	206	2200	434	1205	119
21	185	0	343	1100	123
22	101	1955	149	1230	70
23	101	1840	176	835	61
24	86	35	126	2355	72
25	51	0	72	1445	43
26	45	10	55	1200	39
27	38	0	43	1220	35
28	35	0	39	1240	33
29	30	0	35	1505	27
30	24	10	29	1950	21
TOTAL	1,229		2,066		849
AVERAGE	102		172		71
MAXIMUM	327		565		206
MINIMUM	24		29		21
ACRE FT	2,438				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

JULY 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	17	45	22	1640	11
2	14	115	18	1430	8
3	15	2350	22	1310	10
4	25	1820	30	750	19
5	21	0	27	850	18
6	21	2115	24	210	19
7	21	0	23	2355	17
8	11	5	17	2340	7
9	3	0	7	1340.0	0
10	7	2235	22	340	0
11	20	1715	24	650	17
12	12	0	21	1735	7
13	3	0	7	2355	0
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
31	- - -	- - -	- - -	- - -	- - -
TOTAL	190		264		133
AVERAGE	15		20		10
MAXIMUM	25		30		19
MINIMUM	3		7		0
ACRE FT	377				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

AUGUST 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	123	2345	319	20	70
14	486	820	723	2340	304
15	248	10	311	1015	196
16	424	1455	553	0	289
17	180	35	335	2335	107
18	74	20	110	2345	56
19	49	10	57	2350	44
20	319	1955	1,478	145	43
21	530	15	1,253	2355	212
22	116	0	212	2350	70
23	55	0	70	2350	46
24	42	0	46	1820	41
25	41	115	41	1755	41
26	40	1610	42	2325	40
27	39	10	40	2355	38
28	37	20	38	1550	37
29	37	2300	38	10	37
30	37	15	38	1540	37
31	43	2155	55	45	37
TOTAL	2,920		5,759		1,745
AVERAGE	154		303		92
MAXIMUM	530		1,478		304
MINIMUM	37		38		37
ACRE FT	5,792				

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

SEPTEMBER 1989

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU.FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU.FT/SEC
1	48	0	53	2335	44
2	42	45	44	1310	41
3	44	830	45	2350	43
4	41	5	43	2345	39
5	37	15	39	2355	36
6	37	2355	41	530	35
7	44	1445	47	0	41
8	40	20	44	2350	39
9	37	10	39	2320	36
10	36	2355	41	725	35
11	149	1815	343	0	41
12	171	5	282	2035	130
13	242	1530	396	145	133
14	191	20	304	2335	113
15	74	0	116	2350	56
16	45	10	56	2355	39
17	37	0	39	2335	36
18	34	5	36	620	31
19	30	1600	34	2355	16
20	27	1545	37	1135	2
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	1,406		2,079		986
AVERAGE	70		104		49
MAXIMUM	242		396		133
MINIMUM	27		34		2
ACRE FT	2,789				

APPENDIX C

Surface Water Temperature Records

(Listed Alphabetically)

Note:

TIME OF MAX and TIME OF MIN is military time, e.g. 0 is midnight, 40 is 0040 hours, 615 is 0615 hours, etc.

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

SEPTEMBER 1989

DATE	TEMP DEG. C 0.0	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	6.2	1711	7.7	901	5.0
2	4.5	1	5.5	921	4.0
3	4.6	1911	5.7	726	3.8
4	5.7	1801	7.8	756	4.1
5	6.7	1736	8.7	811	5.1
6	6.5	1656	7.4	711	5.4
7	6.0	1726	8.3	841	4.1
8	5.5	1851	7.5	736	3.4
9	7.2	1746	8.9	801	5.9
10	8.0	1616	9.6	806	7.0
11	6.8	1	7.5	2356	6.0
12	5.8	1741	6.7	911	5.1
13	5.2	1	5.9	2356	4.3
14	2.9	1	4.2	2356	2.1
15	1.7	1	2.1	916	1.3
16	1.4	1701	2.1	846	0.8
17	1.6	1641	2.8	731	0.8
18	1.1	1736	1.8	741	0.4
19	1.0	1706	1.9	2356	0.3
20	0.2	1726	0.6	2056	-0.1
21	0.0	1046	0.1	1916	0.0
22	0.0	1051	0.1	2016	0.0
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	88.6		112.9		68.8
AVERAGE	4.0		5.1		3.1
MAXIMUM	8.0		9.6		7.0
MINIMUM	0.0		0.1		-0.1

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

LOCATION.-Lat 69°49'54", Long 145°55'20", in center W1/2W1/2 S.33, T.6N., R.25E., 13.9 miles upstream with the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-49.2 mi^2, of which 5.6 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature, 19.0°C July 14, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	4.3	0	5.7	1515	3.5
20	6.9	1650	11.5	450	3.0
21	7.6	1440	10.1	605	6.1
22	7.4	1725	10.6	615	4.6
23	8.5	1625	11.4	555	5.5
24	9.7	1510	12.6	650	7.2
25	9.2	1755	12.3	800	7.0
26	10.5	1710	14.3	610	7.1
27	11.2	1735	14.6	655	8.0
28	11.8	1655	14.9	600	8.7
29	11.2	1745	13.4	550	9.0
30	9.8	1735	11.5	1005	8.1
TOTAL	108.1		142.9		77.8
AVERAGE	9.0		11.9		6.5
MAXIMUM	11.8		14.9		9.0
MINIMUM	4.3		5.7		3.0

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

LOCATION.-Lat 60°49'56", long 143°46'50", in center sec.36, T.6N., R.33E., 0.6 mile upstream from confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-97.1 mi^2, of which 66 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature, 19.1°C July 21, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	5.8	1715	9.3	530	2.4
16	6.4	0	7.6	1325	5.7
17	7.2	1435	11.3	530	4.6
18	6.2	1915	9.2	555	3.8
19	5.9	0	7.1	2355	5.2
20	7.5	1935	12.1	620	3.6
21	10.5	1400	12.5	515	9.0
22	9.9	1855	12.8	645	7.3
23	11.3	1550	14.3	555	8.5
24	11.8	1915	13.3	735	10.5
25	11.5	1805	14.5	720	9.1
26	11.5	1930	14.5	625	8.5
27	11.7	1815	14.3	705	9.6
28	11.9	1850	14.9	605	9.4
29	12.0	1830	14.0	700	10.3
30	10.3	5	12.4	1100	8.6
TOTAL	151.4		194.1		116.1
AVERAGE	9.5		12.1		7.3
MAXIMUM	12.0		14.9		10.5
MINIMUM	5.8		7.1		2.4

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	9.8	1910	12.6	705	7.5
2	9.4	2030	11.2	645	7.7
3	11.4	1730	15.5	525	7.8
4	13.8	1535	17.0	540	11.1
5	13.4	1450	15.2	535	11.4
6	14.4	1620	17.5	515	11.9
7	12.6	0	14.3	2355	11.4
8	12.7	1700	15.8	635	10.1
9	14.2	1725	17.4	615	11.0
10	14.8	1715	18.2	630	12.6
11	13.7	1845	15.6	615	12.2
12	14.5	1600	16.5	540	12.5
13	15.3	1810	18.0	610	13.0
14	16.0	1730	19.1	605	13.5
15	15.8	1755	17.9	605	13.7
16	12.4	0	15.3	2355	9.9
17	10.0	1755	11.0	800	8.8
18	11.5	1825	14.8	525	8.2
19	12.2	0	13.3	2355	11.2
20	11.6	1700	13.8	610	9.9
21	9.4	0	11.3	2355	8.0
22	9.0	2120	11.2	535	7.3
23	11.9	1535	14.7	545	9.4
24	11.4	1805	12.7	540	9.8
25	12.1	1545	14.3	610	10.5
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
31	- - -	- - -	- - -	- - -	- - -
TOTAL	313.3		374.2		260.4
AVERAGE	12.5		15.0		10.4
MAXIMUM	16.0		19.1		13.7
MINIMUM	9.0		11.0		7.3

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	13.3	0	14.8	2355	12.0
14	10.4	0	11.9	2355	9.2
15	8.6	0	9.2	705	8.0
16	8.0	1615	8.8	2355	7.2
17	6.5	2020	7.7	805	5.5
18	9.5	1855	12.6	625	6.7
19	11.4	1825	13.1	755	9.9
20	9.7	0	12.2	2355	7.8
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
31	- - -	- - -	- - -	- - -	- - -
TOTAL	77.4		90.3		66.3
AVERAGE	9.7		11.3		8.3
MAXIMUM	13.3		14.8		12.0
MINIMUM	6.5		7.7		5.5

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

LOCATION.-Lat 69°50'19", Long 144°24'43", in NE1/4NW1/4NW1/4 sec.33, T.6N., R.31E., 0.6 mi. upstream from the confluence with the Itkilyariak Creek, 28 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.-26.9 mi^2, of which 8.7 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area.

REMARKS.-This is a 3rd Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature, 17.7°C Aug. 8, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	5.1	1645	9.0	630	1.3
16	4.8	1900	6.0	625	3.6
17	5.8	1415	10.2	515	2.8
18	4.4	1910	7.3	615	2.2
19	4.8	1005	5.5	2355	4.2
20	7.1	1755	11.5	625	2.8
21	9.9	1435	12.2	530	8.3
22	8.9	1815	11.5	715	6.5
23	10.2	1635	13.5	555	7.1
24	11.0	1800	12.7	540	9.7
25	10.5	1715	13.2	730	8.2
26	11.2	1740	14.2	615	8.2
27	11.0	1715	12.9	600	9.1
28	11.0	1710	13.5	505	8.8
29	10.9	1915	12.7	530	9.4
30	9.3	0	11.0	1005	7.9
TOTAL	135.9		176.9		100.1
AVERAGE	8.5		11.1		6.3
MAXIMUM	11.2		14.2		9.7
MINIMUM	4.4		5.5		1.3

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	8.6	1750	11.1	655	6.5
2	8.6	1855	11.0	655	6.5
3	10.4	1800	13.9	555	7.1
4	12.0	1715	14.5	630	9.6
5	11.7	1520	13.4	530	9.8
6	12.6	1500	14.7	755	10.6
7	11.6	0	12.9	2355	10.4
8	11.3	1625	13.9	540	9.3
9	12.5	1735	15.3	555	9.8
10	12.8	1620	15.6	635	11.1
11	12.8	1815	14.8	655	11.1
12	13.3	1750	15.3	530	11.4
13	14.2	1855	16.4	520	12.1
14	14.4	1540	17.1	610	12.2
15	14.3	1720	15.9	540	12.6
16	11.7	0	13.9	2355	9.8
17	9.1	1720	10.8	845	7.3
18	11.1	1750	14.5	520	7.8
19	11.9	1145	13.0	2355	10.7
20	11.5	1600	13.7	615	9.6
21	9.5	0	10.8	2355	8.2
22	9.7	1820	12.4	505	7.2
23	11.6	1425	14.6	520	9.0
24	11.8	1605	14.0	525	9.8
25	11.7	1430	14.2	630	10.2
26	8.6	0	10.7	2355	7.2
27	7.6	1950	10.0	655	5.4
28	9.8	1750	13.3	610	6.4
29	11.8	1715	15.0	530	8.7
30	12.2	1725	15.0	605	9.7
31	11.0	1930	11.7	555	10.5
TOTAL	351.7		423.4		287.6
AVERAGE	11.3		13.7		9.3
MAXIMUM	14.4		17.1		12.6
MINIMUM	7.6		10.0		5.4

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	12.4	1635	15.0	510	10.4
2	11.1	0	12.5	2355	10.1
3	10.0	1855	11.7	1055	8.8
4	11.6	1830	15.1	615	8.2
5	13.9	1715	16.5	655	11.7
6	14.3	1800	16.6	725	12.3
7	14.3	1700	17.2	615	11.7
8	14.8	1655	17.7	550	12.0
9	14.8	1740	16.9	620	12.6
10	13.8	1610	15.6	620	12.5
11	13.5	1650	15.3	635	11.6
12	14.2	135	17.1	545	12.1
13	12.0	0	13.4	2355	10.0
14	9.5	1620	10.4	655	8.6
15	8.3	0	8.9	715	7.6
16	7.6	1550	8.2	2355	6.6
17	6.3	2025	7.7	740	4.8
18	8.7	1720	11.6	645	5.8
19	10.2	1820	12.0	735	8.7
20	8.6	0	10.7	2355	6.8
21	7.6	1800	10.3	705	5.4
22	8.5	1750	11.3	705	6.0
23	8.8	1705	11.4	715	6.2
24	9.0	1620	10.6	630	7.1
25	9.3	1630	10.9	2355	8.1
26	8.7	1855	10.6	600	7.3
27	10.2	1655	12.3	810	8.6
28	8.6	0	9.5	2355	7.8
29	8.2	1705	9.9	730	7.1
30	7.2	0	8.0	2355	6.5
31	6.6	1630	7.7	730	5.5
TOTAL	322.6		382.6		268.5
AVERAGE	10.4		12.3		8.7
MAXIMUM	14.8		17.7		12.6
MINIMUM	6.3		7.7		4.8

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

SEPTEMBER 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	7.0	1715	9.2	755	5.5
2	6.0	0	6.7	855	5.3
3	5.8	1755	6.3	710	5.5
4	6.4	1405	8.3	740	4.5
5	7.3	1555	8.8	745	6.0
6	6.8	1810	7.3	725	6.0
7	6.4	1655	8.5	650	4.6
8	6.1	1740	8.2	725	4.0
9	7.7	1705	9.2	815	6.4
10	8.3	1535	9.6	2355	7.6
11	7.0	0	7.5	2355	6.3
12	6.2	1620	7.1	835	5.4
13	5.2	0	6.2	2355	4.0
14	2.7	0	4.0	2355	1.9
15	1.9	1640	2.9	840	1.1
16	1.5	1705	2.3	805	0.9
17	1.6	1605	2.9	635	0.8
18	0.9	1555	2.0	610	0.0
19	0.8	1555	2.0	2355	0.1
20	0.6	1545	1.6	2055	0.0
21	0.2	1430	0.5	1955	0.0
22	0.2	1440	0.5	0	0.1
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	96.6		121.6		76.0
AVERAGE	4.4		5.5		3.5
MAXIMUM	8.3		9.6		7.6
MINIMUM	0.2		0.5		0.0

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

LOCATION.-Lat 70°35", Long 143°1'54", in NW1/4NW1/4NE1/4 sec.36, T.8N., R.36E., 6 mi. upstream from the mouth, 16.5 mi. south-east of Kaktovik, Alaska.

DRAINAGE AREA.-136.2 mi^2.

REMARKS.-This is a 5th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature; 23.1°C Aug. 9, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX MAXT	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	2.4	1730	4.0	615	1.0
15	3.4	1650	5.8	550	0.9
16	3.2	1810	4.3	620	2.3
17	4.5	1540	8.4	540	1.8
18	4.0	1945	7.2	700	1.4
19	3.9	0	5.0	815	3.1
20	4.8	1955	8.5	710	1.8
21	7.2	1625	9.4	600	4.8
22	7.3	1845	10.2	700	4.6
23	9.2	1845	13.0	750	5.9
24	10.3	2005	12.2	755	8.1
25	9.7	1820	12.8	720	7.0
26	9.4	1915	12.4	655	6.6
27	10.0	1900	13.2	750	7.3
28	11.4	1910	15.0	700	8.1
29	12.3	1940	15.0	710	9.6
30	11.2	0	13.8	1035	8.5
TOTAL	124.2		170.2		82.8
AVERAGE	7.3		10.0		4.9
MAXIMUM	12.3		15.0		9.6
MINIMUM	2.4		4.0		0.9

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	11.1	1900	14.5	730	7.9
2	10.7	0	12.9	900	9.8
3	12.6	2005	17.3	640	8.5
4	16.3	1750	19.1	650	13.3
5	16.2	1530	18.0	555	13.8
6	17.4	1835	20.5	655	14.6
7	15.8	0	19.1	2355	13.6
8	14.7	1925	18.3	715	11.6
9	17.4	1900	20.7	805	14.5
10	18.6	1750	21.7	830	16.0
11	17.9	1915	20.1	755	16.0
12	18.3	1840	20.6	705	15.9
13	19.4	1820	22.2	800	16.6
14	20.2	1940	22.9	745	17.6
15	20.2	1930	22.2	710	17.6
16	16.5	0	21.0	2355	12.7
17	13.9	2045	16.4	650	11.6
18	16.5	1935	20.1	710	13.0
19	17.6	1350	19.9	2355	16.2
20	15.5	1840	17.6	920	13.5
21	13.0	0	16.0	2355	11.2
22	12.4	2015	15.6	705	10.2
23	16.2	1705	19.9	625	12.8
24	16.7	1845	18.6	805	15.0
25	17.6	1730	20.8	700	15.0
26	14.3	0	17.3	2355	13.0
27	13.4	1750	16.1	815	11.0
28	15.1	1800	17.8	720	12.4
29	16.8	1920	20.5	640	13.5
30	17.1	1810	19.5	750	14.6
31	15.8	0	17.2	950	14.8
TOTAL	495.2		584.4		417.8
AVERAGE	16.0		18.9		13.5
MAXIMUM	20.2		22.9		17.6
MINIMUM	10.7		12.9		7.9

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	16.2	1805	18.5	805	14.8
2	14.8	0	17.1	1100	14.1
3	13.9	2020	16.1	1010	12.3
4	16.0	1945	19.7	630	12.8
5	19.2	1845	22.6	750	16.6
6	20.2	1700	22.4	745	18.0
7	18.3	1750	20.0	740	16.5
8	18.5	1925	22.0	715	15.4
9	19.6	1620	23.1	740	16.7
10	18.7	1705	20.6	725	16.6
11	18.1	1730	20.5	820	15.8
12	18.5	1845	21.2	800	16.1
13	16.8	0	18.6	2355	15.7
14	15.1	1435	15.8	2355	14.3
15	13.3	0	14.3	905	12.7
16	12.4	1815	13.4	910	11.5
17	10.3	0	11.6	950	9.1
18	12.4	1920	15.5	650	9.9
19	15.2	2030	17.2	740	13.4
20	13.6	0	16.7	2355	11.8
21	12.3	1935	14.6	750	10.6
22	13.2	1900	15.6	755	10.9
23	13.4	1900	15.7	820	11.2
24	13.9	1820	15.7	755	11.6
25	14.4	1610	15.3	2355	12.9
26	13.1	2105	14.6	805	11.6
27	14.9	1815	16.7	950	13.7
28	13.1	0	15.0	2355	12.0
29	12.0	1820	12.8	750	11.2
30	11.1	0	12.2	2350	10.6
31	10.8	1940	12.0	810	9.7
TOTAL	463.3		527.1		410.1
AVERAGE	14.9		17.0		13.2
MAXIMUM	20.2		23.1		18.0
MINIMUM	10.3		11.6		9.1

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

SEPTEMBER 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	11.7	1740	12.9	800	10.8
2	10.5	0	11.6	955	10.1
3	10.2	1645	10.4	2340	9.9
4	11.0	1930	13.1	800	9.5
5	11.7	1955	13.0	825	10.4
6	12.0	1705	13.1	825	10.9
7	11.7	1710	13.1	845	10.6
8	11.4	1855	13.4	835	9.4
9	13.0	1755	14.0	910	12.1
10	13.5	1720	15.3	715	12.3
11	12.7	0	13.8	2355	12.3
12	11.7	0	12.2	1030	11.2
13	11.1	0	12.0	2355	10.3
14	8.5	0	10.3	2350	7.4
15	6.8	0	7.4	930	6.3
16	6.5	1720	7.2	730	6.0
17	6.4	1805	7.4	800	5.6
18	5.7	0	6.3	615	5.6
19	5.7	1825	5.9	440	5.6
20	5.8	1755	6.2	40	5.6
21	5.7	1510	5.9	2030	5.7
22	5.8	1415	5.9	10	5.7
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	209.1		230.4		193.3
AVERAGE	9.5		10.5		8.8
MAXIMUM	13.5		15.3		12.3
MINIMUM	5.7		5.9		5.6

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

LOCATION.-Lat 69°39'30", Long 144°22'52", in NW1/4SW1/4 sec.31, T.4N., R.32E., 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.-520.1 mi^2, of which 517.5 mi^2 are located within the Arctic National Wildlife Refuge Wilderness area. Glaciers account for 2.3 percent of the drainage area or about 12 mi^2 depending on existing climatic conditions.

REMARKS.-This is a 6th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature, 15.9°C Aug. 13, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	---	---	---	---	---
18	---	---	---	---	---
19	5.5	1945	8.6	635	2.6
20	7.7	1415	9.4	700	6.1
21	9.1	2110	13.3	550	5.7
22	9.2	0	11.7	950	7.6
23	8.6	1925	11.7	730	5.8
24	9.1	1855	10.8	755	7.3
25	7.4	0	9.6	735	5.5
26	7.5	1935	10.0	900	5.5
27	9.3	1815	12.5	630	6.3
28	9.8	1815	12.2	815	7.5
29	9.8	1825	12.4	835	7.6
30	9.5	1945	11.1	755	7.8
TOTAL	102.5		133.3		75.3
AVERAGE	8.5		11.1		6.3
MAXIMUM	9.8		13.3		7.8
MINIMUM	5.5		8.6		2.6

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	7.5	0	10.1	2355	6.4
2	6.8	1910	9.3	510	4.8
3	7.2	2035	9.9	730	4.9
4	10.0	1935	13.5	630	6.6
5	12.0	1755	14.1	640	9.5
6	11.4	1805	13.0	650	9.9
7	12.1	1540	14.0	540	10.1
8	11.0	0	12.8	910	10.2
9	10.6	1735	13.1	730	8.9
10	11.4	1815	14.4	645	8.4
11	11.5	1710	13.6	825	9.8
12	10.2	1940	12.0	625	8.6
13	10.5	1815	12.3	650	8.5
14	11.3	2015	13.7	730	9.3
15	11.6	1845	13.1	730	9.8
16	11.2	1825	12.6	715	9.4
17	9.3	0	11.1	2355	7.5
18	7.0	1930	8.9	810	5.5
19	8.7	1945	11.9	615	5.8
20	9.9	1510	10.9	745	9.0
21	9.6	1805	11.5	625	8.0
22	7.9	0	9.4	940	7.2
23	8.9	1940	11.1	710	6.8
24	9.8	1810	12.2	745	7.6
25	9.3	1735	10.9	720	7.7
26	9.8	1545	11.5	810	8.0
27	7.6	0	9.9	945	6.7
28	7.1	1850	8.8	810	5.0
29	8.8	1940	12.2	705	5.7
30	10.9	1855	14.0	700	7.9
31	11.9	1815	14.8	735	8.9
TOTAL	302.8		370.6		242.4
AVERAGE	9.8		12.0		7.8
MAXIMUM	12.1		14.8		10.2
MINIMUM	6.8		8.8		4.8

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	11.5	0	13.5	820	10.6
2	11.9	1715	13.8	820	10.3
3	10.4	0	12.3	1100	9.7
4	9.2	2020	10.4	1000	7.9
5	10.1	1920	13.0	700	7.5
6	11.8	1920	14.3	545	9.6
7	12.5	1720	14.8	630	10.6
8	12.9	1850	15.6	700	10.5
9	12.6	2000	14.9	705	10.0
10	13.4	1725	15.4	715	11.2
11	13.5	1605	15.1	745	12.2
12	12.3	1600	13.8	755	10.2
13	13.4	1700	15.9	735	10.9
14	11.7	0	14.2	2355	10.1
15	9.0	1825	10.1	735	8.0
16	7.8	0	8.9	825	6.7
17	7.7	0	8.6	2355	7.2
18	7.5	1955	9.8	745	5.6
19	9.4	1930	11.8	725	7.0
20	10.6	1935	12.0	825	9.3
21	9.0	0	11.3	2355	7.1
22	7.5	1910	9.7	800	5.7
23	8.0	1855	10.4	730	5.7
24	8.6	1835	11.1	805	6.0
25	8.8	1735	10.3	830	6.9
26	8.9	0	9.7	830	7.7
27	9.4	2015	10.6	740	8.5
28	10.5	1810	11.9	905	9.1
29	9.4	0	10.8	845	8.2
30	9.2	2020	10.4	805	7.7
31	8.7	0	10.0	1000	7.3
TOTAL	317.2		374.4		265.0
AVERAGE	10.2		12.1		8.5
MAXIMUM	13.5		15.9		12.2
MINIMUM	7.5		8.6		5.6

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

SEPTEMBER 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	8.6	1910	9.8	845	7.1
2	8.3	1850	10.0	825	6.9
3	7.0	0	8.5	945	6.2
4	7.0	1930	7.7	835	6.4
5	7.6	1935	9.2	735	6.4
6	8.2	1830	9.2	840	6.9
7	7.8	0	8.5	2355	7.0
8	6.6	1915	8.3	840	4.9
9	6.4	2215	8.2	830	4.4
10	8.4	2050	9.7	820	7.0
11	9.6	1705	10.7	715	8.7
12	8.4	0	9.6	2355	7.6
13	6.9	1905	7.9	900	5.6
14	5.5	0	7.2	2355	4.5
15	3.0	0	4.4	2355	2.2
16	2.2	1750	2.9	725	1.7
17	1.8	0	2.4	935	1.3
18	1.6	1705	2.4	835	0.8
19	1.2	1650	2.0	930	0.4
20	0.3	0	1.1	2335	0.0
21	0.1	1700	0.7	0	0.0
22	0.1	1640	0.2	30	0.0
23	0.1	1440	0.2	450	0.0
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	116.7		140.8		96.0
AVERAGE	5.1		6.1		4.2
MAXIMUM	9.6		10.7		8.7
MINIMUM	0.1		0.2		0.0

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

LOCATION.-Lat 69°39'53", Long 144°24'52", in NE1/4NW1/4 sec.36, T.4N., R.31E., 3000 ft. downstream of Sadlerochit Spring, 37.5 mi. southwest of Kaktovik, Alaska.

DRAINAGE AREA.-0.5 mi^2.

REMARKS.-This a 2nd Order drainage with 2 springs contributing most of the flow.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature, 15.9°C Aug. 7, 1989; Minimum Temperature 9.6°C July 17 and Aug. 20, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	---	---	---	---	---
15	---	---	---	---	---
16	---	---	---	---	---
17	---	---	---	---	---
18	11.7	1640	13.7	545	10.0
19	12.1	1145	13.6	20	11.4
20	13.4	1435	15.5	220	11.0
21	13.0	1315	15.5	2355	12.1
22	13.1	1640	15.0	500	11.8
23	13.2	1435	15.0	145	11.8
24	12.8	1255	14.0	410	12.0
25	13.1	1500	15.0	440	11.9
26	13.7	1440	15.5	250	11.6
27	13.5	1240	15.0	405	12.2
28	13.6	1605	15.4	315	12.0
29	13.4	1255	14.6	145	12.1
30	12.2	1740	12.9	915	11.4
TOTAL	168.8		190.7		151.3
AVERAGE	13.0		14.7		11.8
MAXIMUM	13.7		15.5		12.2
MINIMUM	11.7		12.9		11.0

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	12.8	1530	14.5	420	11.4
2	12.6	1250	13.7	125	11.5
3	13.8	1430	15.6	250	11.9
4	13.8	1155	15.3	405	12.7
5	13.6	1405	15.3	255	12.3
6	14.0	1225	15.6	145	12.9
7	13.0	1105	13.8	1920	12.5
8	13.5	1705	15.1	245	12.3
9	13.9	1505	15.5	220	12.1
10	13.6	1515	15.8	2355	11.7
11	12.8	1715	14.6	150	10.9
12	13.8	1330	15.4	435	12.5
13	13.8	1310	15.1	100	12.9
14	13.8	1510	15.5	345	12.8
15	13.6	1305	15.1	420	12.5
16	12.2	0	12.8	2355	10.9
17	11.6	1740	13.3	330	9.6
18	13.2	1610	14.9	335	11.5
19	12.8	1255	13.3	2355	12.2
20	13.0	1500	14.1	310	12.1
21	12.0	1420	12.6	2345	11.4
22	12.9	1515	14.8	30	11.3
23	13.1	1310	15.2	210	12.0
24	12.9	1345	14.1	425	11.8
25	13.0	1400	14.9	2355	12.0
26	11.1	0	12.0	720	10.4
27	11.8	1510	13.0	400	10.4
28	13.0	1440	14.7	245	11.3
29	13.5	1500	15.1	250	12.2
30	13.6	1440	15.1	145	12.3
31	13.1	1825	13.4	330	12.7
TOTAL	405.2		449.2		367.0
AVERAGE	13.1		14.5		11.8
MAXIMUM	14.0		15.8		12.9
MINIMUM	11.1		12.0		9.6

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	13.7	1310	15.1	245	12.9
2	12.9	0	13.1	2345	12.4
3	12.2	1815	13.1	1115	11.1
4	13.2	1450	15.0	500	11.7
5	13.6	1445	15.0	120	12.4
6	13.7	1405	15.1	550	12.6
7	13.8	1235	15.9	355	12.6
8	13.8	1500	15.3	535	12.8
9	13.6	1435	14.8	340	12.8
10	13.4	1355	14.9	340	12.6
11	13.4	1410	14.8	430	12.6
12	13.6	1500	15.2	410	12.7
13	12.6	1135	13.7	2250	11.6
14	12.0	1025	12.8	155	11.5
15	12.0	1730	12.7	550	11.6
16	11.8	1455	12.3	2355	11.4
17	11.9	1445	13.0	625	11.0
18	13.0	1425	14.2	120	11.9
19	13.1	1610	13.8	15	12.6
20	11.0	205	12.8	1415	9.6
21	12.0	1445	13.9	0	10.6
22	12.5	1435	13.9	350	11.5
23	12.7	1415	14.0	610	11.7
24	12.8	1125	13.7	600	12.1
25	12.5	1015	13.1	2140	12.1
26	12.8	1600	13.7	0	12.3
27	12.9	1430	14.0	2235	12.3
28	12.5	1525	13.3	530	12.0
29	12.5	1245	13.0	640	11.9
30	12.4	1300	13.1	600	12.0
31	12.2	1445	13.0	445	11.5
TOTAL	396.1		431.3		370.4
AVERAGE	12.8		13.9		11.9
MAXIMUM	13.8		15.9		12.9
MINIMUM	11.0		12.3		9.6

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

SEPTEMBER 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	12.4	1445	13.5	2355	11.5
2	12.0	1420	12.8	255	11.4
3	12.2	1735	12.5	2230	11.9
4	12.4	1610	13.1	135	11.9
5	12.6	1235	13.5	10	12.1
6	12.2	1635	12.6	2320	11.7
7	12.2	1340	13.2	710	11.4
8	12.5	1520	13.4	130	11.7
9	12.8	1215	13.5	440	12.2
10	12.8	1445	13.8	2355	12.2
11	12.3	1350	12.6	2230	11.9
12	12.2	1435	12.8	455	11.7
13	11.5	25	12.0	2155	10.8
14	10.9	1510	11.4	2345	10.4
15	11.2	1355	11.9	0	10.4
16	11.1	250	11.3	940	10.8
17	11.5	1415	12.0	2335	10.7
18	11.0	1500	11.6	535	10.2
19	11.4	1215	12.0	2355	10.7
20	10.8	1330	11.8	2200	10.3
21	10.9	1345	11.9	150	10.2
22	11.3	1355	12.0	2050	10.9
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	260.2		275.2		247.0
AVERAGE	11.8		12.5		11.2
MAXIMUM	12.8		13.8		12.2
MINIMUM	10.8		11.3		10.2

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

LOCATION.-Lat 69°54'43", Long 142°30'52", in SE1/4SE1/4 sec.36, T.7N., R.38E., at confluence with the West Fork Sikrelurak River, 31 mi. south-east of Kaktovik, Alaska.

DRAINAGE AREA.-74.7 mi^2.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during breakup and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum temperature, 18.4°C July 14 and Aug. 9, 1989.

JUNE 1989

DATE	TEMP DEG. C AVG	TIME OF MAX MAXT	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	---	---	---	---	---
2	---	---	---	---	---
3	---	---	---	---	---
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6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---
11	---	---	---	---	---
12	---	---	---	---	---
13	---	---	---	---	---
14	2.1	1530	4.1	540	0.4
15	3.3	1735	6.6	445	0.1
16	3.2	1910	4.9	420	1.7
17	5.2	1515	10.6	505	1.4
18	4.3	1815	7.9	540	1.3
19	3.9	1930	5.5	830	2.7
20	4.7	1850	8.2	620	1.7
21	6.8	1900	9.3	525	3.9
22	7.3	1400	10.1	745	4.4
23	8.5	1710	12.9	810	5.1
24	9.0	1430	11.1	720	7.1
25	8.8	1655	12.4	655	5.8
26	8.6	1735	11.9	520	5.5
27	8.8	1755	12.6	555	5.7
28	10.1	1650	13.9	550	6.3
29	9.9	1505	13.0	540	7.0
30	8.7	1700	11.4	1025	6.0
TOTAL	113.2		166.4		66.1
AVERAGE	6.7		9.8		3.9
MAXIMUM	10.1		13.9		7.1
MINIMUM	2.1		4.1		0.1

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

JULY 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	8.6	1725	12.6	605	5.0
2	7.7	0	8.9	520	6.3
3	- - -	- - -	- - -	- - -	- - -
4	12.8	1605	16.9	555	8.8
5	12.5	1540	15.6	540	9.3
6	12.9	1545	16.7	635	9.9
7	11.0	0	13.1	2355	8.9
8	10.4	1815	14.2	635	7.0
9	12.3	1740	16.3	700	9.1
10	12.6	1815	16.8	645	9.8
11	12.6	1750	15.2	430	10.5
12	13.0	1650	16.4	545	10.1
13	14.0	1725	18.3	655	10.7
14	14.5	1640	18.4	730	11.7
15	14.5	1800	16.7	655	12.3
16	11.7	0	14.8	2355	9.0
17	9.9	1835	12.4	650	7.5
18	12.1	1635	16.1	605	8.0
19	12.6	1345	14.9	2355	11.2
20	10.8	1635	13.1	755	8.9
21	8.1	0	10.4	2355	6.5
22	8.7	1810	11.9	245	6.2
23	11.3	1615	15.1	530	8.2
24	11.6	1835	13.9	645	10.0
25	12.7	1720	16.1	535	10.0
26	10.3	0	12.3	2355	9.0
27	9.5	1615	12.3	620	7.0
28	10.6	1720	13.5	630	7.6
29	12.0	1740	15.6	535	8.6
30	12.3	1735	15.1	625	9.8
31	11.3	1715	12.6	635	10.4
TOTAL	337.2		427.3		261.0
AVERAGE	11.2		14.2		8.7
MAXIMUM	14.5		18.4		12.3
MINIMUM	7.7		8.9		5.0

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

AUGUST 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	12.1	1745	14.8	520	10.1
2	11.0	0	12.2	810	10.2
3	10.7	1835	13.1	735	9.0
4	11.9	1830	15.3	625	8.9
5	14.6	1720	18.0	555	11.6
6	15.7	1610	18.3	815	13.7
7	14.5	1555	16.7	640	12.5
8	14.8	1750	18.0	635	11.9
9	15.3	1555	18.4	700	12.6
10	15.2	1610	18.2	545	12.7
11	14.5	1520	16.9	725	12.7
12	14.7	1610	17.7	620	12.5
13	13.2	0	14.2	2355	11.8
14	11.9	1425	13.2	550	10.8
15	10.1	0	11.0	2355	9.2
16	8.6	1710	9.8	2355	7.2
17	6.7	1825	8.5	840	5.2
18	8.5	1645	11.7	635	5.7
19	10.7	1435	13.0	620	8.5
20	9.4	0	11.6	2355	7.8
21	8.6	1810	11.2	715	6.9
22	9.1	1720	11.9	700	6.4
23	9.2	1730	12.3	725	6.3
24	9.8	1725	12.5	705	6.8
25	10.1	1400	11.6	2355	8.2
26	9.2	1650	11.5	655	7.2
27	10.7	1625	12.7	750	9.5
28	8.6	0	10.0	2355	7.6
29	7.8	1720	8.7	715	6.9
30	6.7	0	7.6	2355	6.2
31	6.6	1750	8.2	740	5.3
TOTAL	340.5		408.8		281.9
AVERAGE	11.0		13.2		9.1
MAXIMUM	15.7		18.4		13.7
MINIMUM	6.6		7.6		5.2

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

SEPTEMBER 1989

DATE	TEMP DEG. C AVG	TIME OF MAX TEMP	TEMP DEG.C MAX	TIME OF MIN TEMP	TEMP DEG.C MIN
1	7.1	1615	8.7	705	6.0
2	5.8	0	6.5	825	5.3
3	5.4	1515	5.8	2355	4.9
4	6.1	1625	8.0	640	4.5
5	6.5	1635	8.2	655	4.9
6	6.9	1540	8.3	740	5.5
7	6.6	1610	8.3	835	5.3
8	6.1	1715	8.1	820	3.8
9	7.3	1620	8.6	810	6.0
10	8.1	1710	10.4	205	6.6
11	7.4	0	8.4	2355	6.7
12	6.4	1620	7.3	920	5.7
13	5.4	0	6.4	2355	4.7
14	3.3	0	4.7	2355	2.3
15	2.0	1810	2.3	820	1.6
16	1.4	1655	1.9	805	1.0
17	0.9	1755	1.6	925	0.5
18	0.3	0	0.6	2320	0.1
19	0.2	1800	0.3	2155	0.1
20	0.2	1715	0.4	145	0.1
21	0.1	1440	0.2	2350	0.0
22	0.1	1455	0.1	40	0.0
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	93.6		115.1		75.6
AVERAGE	4.3		5.2		3.4
MAXIMUM	8.1		10.4		6.7
MINIMUM	0.1		0.1		0.0

WATER RESOURCE INVENTORY AND ASSESSMENT, ARCTIC NATIONAL WILDLIFE REFUGE, 1990 STREAM DISCHARGE GAGING DATA

Alaska Fisheries Progress Report

May 1991

Region 7
U.S. Fish and Wildlife Service • Department of the Interior

WATER RESOURCE INVENTORY AND ASSESSMENT

ARCTIC NATIONAL WILDLIFE REFUGE

1990 Stream Discharge Gaging Data

Alaska Fisheries Progress Report

Steven M. Lyons
John M. Trawicki

Fisheries Management Services
Water Resource Branch
U.S. Fish and Wildlife Service
Department of the Interior
Anchorage, Alaska

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1990 STREAM DISCHARGE

Introduction

This progress report is intended to provide an accounting of the accomplishments made during the third year of a multi-year water resource inventory on the coastal plain (1002 area) of the Arctic National Wildlife Refuge (ANWR). This progress report is intended to provide stream discharge and water temperature data for consideration in other inventory or management activities. The data represents the hydrologic conditions for the 1990 summer season.

The 1002 area of the Arctic National Wildlife Refuge is located in the remote northeast corner of Alaska adjacent to the Beaufort Sea. Because of the remoteness, extreme climatic conditions, small populace, and lack of competitive water use in the past, there has been little interest in the water resources (water yields, discharge rates, flood frequencies, etc.) from state, federal, or private agencies. The nearest stream gaging station (U.S. Geological Survey gage #15908000, Sagavanirktok River) is located 80 miles to the west of the Canning River, the western boundary of the 1002 area. The Sagavanirktok River is larger than any river in the 1002 area, therefore the database of the Sagavanirktok River can not be extrapolated to provide discharge and flood information for the rivers in the 1002 area.

Hydrologic data for the 1002 area is limited. Childers et al. (1977) reported a reconnaissance level investigation of rivers, springs, aufeis fields, and lakes of the Arctic coastal plain including the 1002 area. Childers et al. (1977) reported data on channel characteristics, watershed characteristics, and estimated flood characteristics of the Canning River, Marsh Creek, Sadlerochit River, Hulahula River, Jago River, and Okerokovik River. Childers et al. (1977) also reported discharge rates and selected water quality parameters for the Katakturuk River Springs, Sadlerochit Springs, Hulahula River Spring, and Okerokovik River Springs. Six lakes were sampled for water quality, and ice thickness and lake depths were reported.

Daum et al. (1984), Glesne and Deschermeier (1984), and Smith and Glesne (1982) reported selected physical and chemical characteristics of streams and springs across the 1002 area. Elliott and Lyons (1990) reported on the availability of winter water within stream systems within the 1002 area. The quantity and distribution of water within lakes of the 1002 area was conducted and reported by Elliott (1990), and Trawicki et al. (1991).

There are no precipitation gages located within the 1002 area. The closest precipitation gage is located on Barter Island, and is operated by the U.S. Soil Conservation Service (SCS). The SCS maintains six other precipitation gages in the Arctic region located at: Atigun Camp, Atigun Pass, Barrow, Prudhoe Bay, Sagwon, and Toolik River. The data collected from these gages is not representative of precipitation events that occur in the drainage basins of the 1002 area. A combination of the data from the SCS precipitation gages located in the Arctic region provide a general indication of seasonal and annual precipitation accumulation for region.

U.S. Fish and Wildlife Service (1989) and Lyons (1990) collected and reported discharge and temperature data for several rivers and streams in the 1002 area for the calendar years of 1988 and 1989 respectively. This progress report is a continuation of these studies. The objectives of the 1990 activities were to continue the quantification of water yield and seasonal stream discharge and to measure stream water temperatures of watersheds within the 1002 area of the ANWR. At the conclusion of the multi-year water resource inventory stream discharge rates, discharge frequency distributions, average monthly water yields, and flood frequencies and sizes will be quantified.

Methods

The Water Resources Branch initiated a stream gaging network consisting of eight gaging stations in the 1002 area in 1988. In 1989 the stream gaging network was expanded to 10 gaging stations (Figure 1). The new gaging stations were located on the Niguanak and Sikrelurak Rivers. Stream discharge data was collected for the Tamayariak River, West Fork of Itkilyariak Creek, Sadlerochit River, Sadlerochit Spring Creek, Akutoktak River, Niguanak River, and Sikrelurak River. Table 1 contains the legal description of the location of each stream gage. Since the Tamayariak River is a hydrologically diverse system with abundant fish and wildlife resources, four stream discharge gages were installed on this watershed.

Water depth was measured at all ten gaging stations using submerged pressure transducers. Eight gaging stations were also equipped with temperature thermistors. Each pressure transducer and temperature thermistor was connected to a computerized field recorder. Measurements were taken at five minute intervals. Water depth was measured to the nearest 0.01 ft and temperature to the nearest 0.1°C. The field recorder

Table 1.-Stream gaging station locations.

Watershed	Gage Location
Akutoktak River	Center Sec. 36, T6N, R33E
West Fork, Itkilyariak Creek	NE¼ NW¼ NW¼ Sec. 33, T6N, R31E
Niguanak River	NW¼ NW¼ NE¼ Sec. 36, T8N, R36E
Sadlerochit River	NW¼ SW¼ Sec. 31, T4N, R32E
Sadlerochit Spring Creek	NE¼ NW¼ Sec. 36, T4N, R31E
Sikrelurak River	SE¼ SE¼ Sec. 36, T7N, R38E
Tamayariak River	SW¼ NE¼ Sec. 35, T6N, R26E
Lower West Fork, Tamayariak River	NW¼ NW¼ Sec. 12, T7N, R25E
Middle Fork, Tamayariak River	Center Sec. 12, T7N, R25E
Upper West Fork, Tamayariak River	W½ W½ Sec. 33, T6N, R25E

summarizes the data automatically for each 24 hour period into a report that includes: average depth, maximum depth, time of maximum depth, minimum depth, time of minimum depth, average temperature, maximum temperature, time of maximum temperature, minimum temperature, and time of minimum temperature. This data is stored on a data storage pack that can later be down-loaded onto a computer.

Weekly visits were scheduled to each gaging station to collect calibration data. More frequent visits were made to each gaging station during extreme high or low flow periods to increase the range of calibration data collected. Calibration data were collected using standard stream discharge measurement procedures (Buchanan and Somers 1969, and Lyons 1988) and included stream discharge in cubic feet per second (cfs), water depth, and water surface elevation. Through regression analysis of water depth (x) and stream discharge (y), a linear or polynomial regression equation was obtained for each stream gage. Using the regression equation developed for each stream, water depth data collected by each field recorder was converted to stream discharge.

Average daily discharge was estimated for gaging stations that experienced technical problems during the stream gaging period. A linear relationship was established between a stream with missing records and a stream with similar watershed characteristics and discharge rates. The relationship was established from the average daily discharge for all days that the two streams had recorded records in common. The linear relationship was used to estimate the missing average daily discharge of one stream from the known average daily discharge of the other stream.

Results

All ten stream gaging stations were installed by June 13, 1990, and most were in service until September 19, 1990. Calibration data was collected from June 13 through September 3. Additional calibration data was collected during high and low flow periods, increasing the range of calibration. From the calibration data polynomial regression equations were obtained for each stream gaging station (Table 2), except for Sadlerochit Spring Creek, where a linear relationship was used. The coefficients of determination (R^2) ranged from 0.949 to 0.999. Utilizing these regression equations, water depth measurements recorded with the stream gaging equipment were converted to stream discharge (Appendix A).

In general, 1990 has the lowest discharge records for the three years of data collection. The average daily discharge of the Tamayariak River and Sadlerochit Springs (Figures 2 and 3), clearly show the extreme low flows of 1990 as compared with 1988 and 1989 average daily discharges. Figures 2 and 3 are also representative of the variability in discharge for the three years of record for all streams within the 1002 area. Discharge measurements of zero or less than one cubic feet per second (cfs) were recorded at several gaging stations: Akutoktak River, West Fork Itkilyariak Creek, Niguanak River, Sikrelurak River, Middle Fork Tamayariak River, and

Table 2.-Regression equations from stream discharge calibration data.

Watershed	Regression Equation	R^2
Akutoktak River	$y = -14.7 + 105.4x - 94.9x^2 + 23.0x^3$	0.999
West Fork, Itkilyariak Creek	$y = 13.2 - 55.3x + 47.5x^2 + 21.0x^3$	0.995
Niguanak River	$y = 1120.6 - 788.8x + 136.5x^2$	0.996
Sadlerochit River	$y = -48.7 + 139.2x - 100.6x^2 + 47.0x^3$	0.998
Sadlerochit Spring Creek	$y = 19.8 + 14.1x$	0.949
Sikrelurak River	$y = 582.9 - 578.3x + 143.4x^2$	0.997
Tamayariak River	$y = -206.1 + 529.2x - 459.9x^2 + 166.6x^3$	0.999
Lower West Fork, Tamayariak River	$y = -60.3 + 140.6x - 118.1x^2 + 41.8x^3$	0.999
Middle Fork, Tamayariak River	$y = -86.1 + 173.3x - 117.6x^2 + 26.8x^3$	0.991
Upper West Fork, Tamayariak River	$y = -1768.2 + 1727.1x - 564.0x^2 + 61.7x^3$	0.997

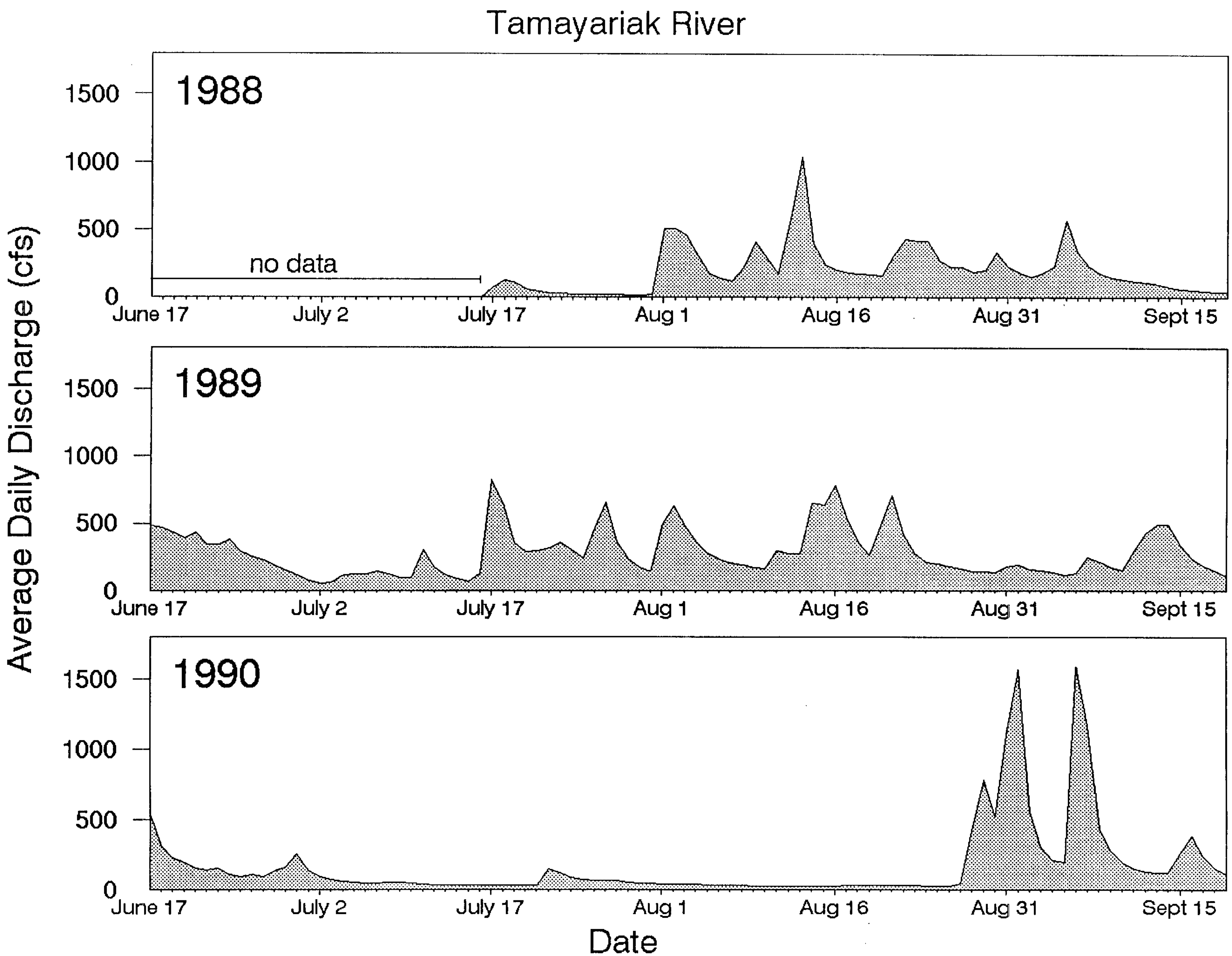

Figure 2.-Comparison of discharge records for the Tamayariak River for the three years of record, 1988-1990.

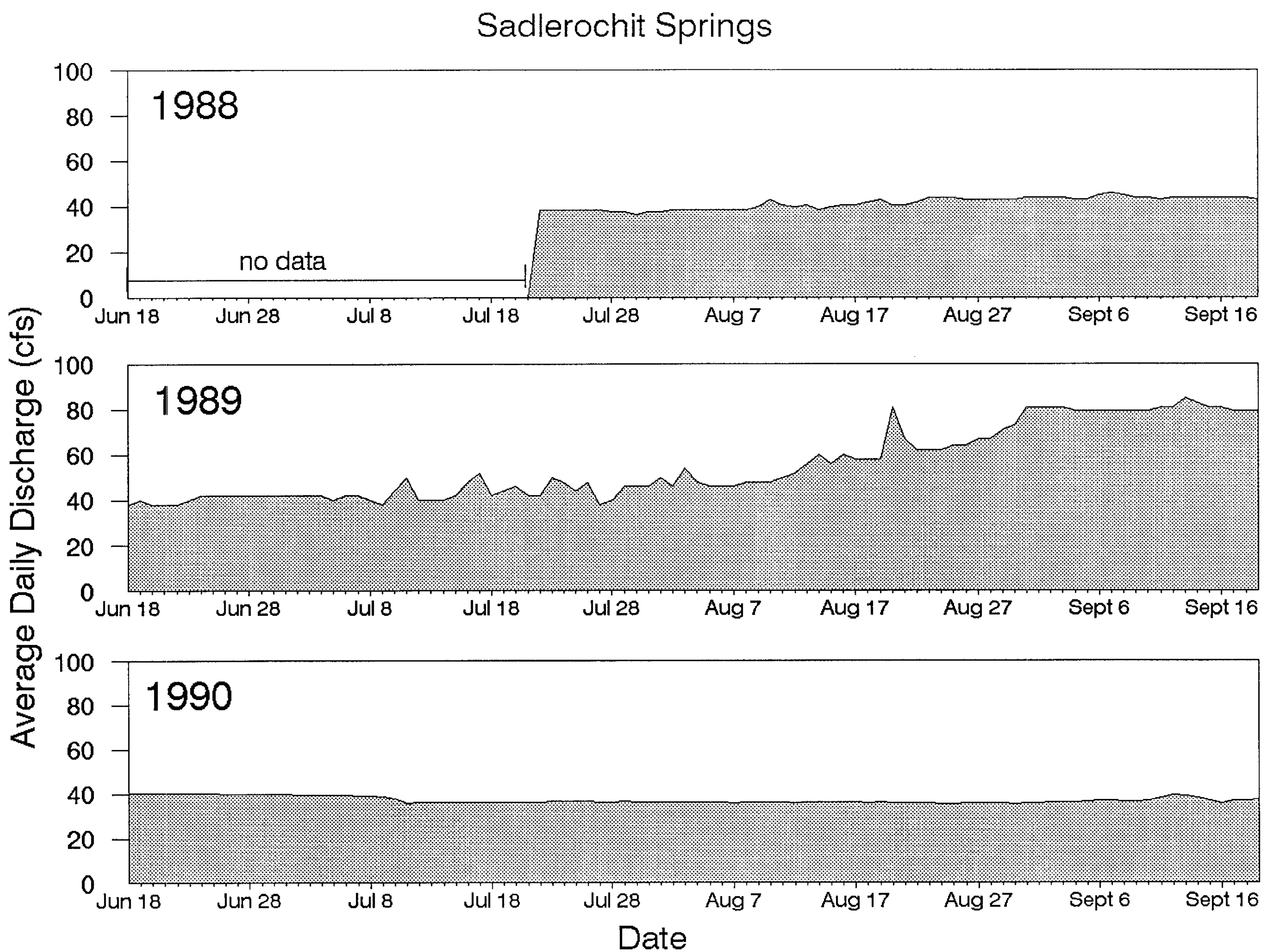

Figure 3.-Comparison of discharge records for Sadlerochit Springs for the three years of record, 1988-1990.

Upper West Fork Tamayariak River. These extremely low flows persisted through July and most of August. Approximately half the total discharge for the entire year came at the end of August and during September when the first significant precipitation events occurred.

Water temperature measurements taken from the eight gaging stations equipped with temperature thermistors are given in Appendix B. The Niguanak River and the mainstem of the Tamayariak River gaging stations were not equipped to collect temperature data. The daily average water temperature as well as the maximum and minimum temperatures and the time of each are provided.

Equipment malfunction, and destruction or movement of pressure transducers, temperature thermistors, and field recorders by wildlife were the causes of data gaps at several stream gaging stations throughout the gaging period (Table 3). A brown bear damaged the gaging equipment at the Niguanak River gaging station on July 9th. Several attempts to repair the field recorder failed. Data collection was discontinued at this gaging station and the field recorder was returned to the manufacturer for repair. The temperature thermistor for Sadlerochit Springs began malfunctioning on September 11. The problem was not evident until the data was down loaded from the field recorder. Nine days of temperature data were lost from the Sadlerochit Springs Creek gaging station.

Table 3.-Summary of missing 1990 stream discharge and temperature data.

Gaging Station	No. Days	Dates of Missing Data	Remarks
Lower West Fork Tamayariak River	26	6/14-7/9	Cable connecting pressure and temperature probes to field recorder was chewed in half.
Middle Fork Tamayariak River	3	6/21-6/23	Bear ripped cable out of the ground. Probes were reset.
Niguanak River	73	7/9-9/19	Bear destroyed gaging station and field recorded. Equipment was returned to manufacturer for repair.
Sadlerochit River	16	9/4-9/19	Field recorder stopped logging data.
Sadlerochit Springs	9	9/11-9/19	Temperature thermistor malfunctioned.
Tamayariak River	100	6/12-9/19	Temperature thermistor was not installed. No temperature data was collected.
Niguanak River	100	6/12-9/19	Temperature thermistor was not installed. No temperature data was collected.

In an effort to estimate missing data at the Niguanak River gaging station a comparison of the average daily discharge was conducted for the Niguanak and Sikrelurak Rivers. The Sikrelurak River is adjacent to the Niguanak and similar in drainage area. A strong linear relationship (R^2=0.91) was established between the Sikrelurak and Niguanak Rivers. The relationship was based on average daily discharge records that the two streams had in common for 1989 and 1990. All estimated discharge records are reported in Appendix A. Regression analysis to estimate missing data was attempted but no relationships were found for the remaining missing discharge data.

Discussion

Fiscal year 1990 was the third year of a 5-year water resource inventory program (1988-1992) designed to quantify stream discharge rates, discharge frequency distribution, average monthly water yields, and flood frequencies and sizes within the 1002 area of the Arctic National Wildlife Refuge. Figures 2 and 3 clearly show the extreme variability in discharge data for the three years of record and illustrate the need of multi-years of discharge data before quantification of drainage basin characteristics can be made.

The 1990 water year is the driest year for the three years of record (Figure 2). Discharge in 1990 was approximately 50% of the 1989 discharge. Discharges of zero or less than one cfs were recorded on several streams during July and August. It should be noted that more than half of the 1990 water yield came in late August and September. The high flows late in the summer can be attributed to snow and rain events followed by warm air temperatures. If September is removed from the database, the 1990 average daily discharge per square mile is only 25 percent of 1989.

Precipitation records from gages located in the Arctic region indicate that precipitation for the 1990 water year ranged from 66% of the long term average at Sagwon to 83% of the long term average at Toolik River (Soil Conservation Service 1989 and unpublished). The 1990 precipitation records for Barter Island are incomplete. Discharge records from Sadlerochit Springs Creek, a deep groundwater spring, support the precipitation records for 1989 and 1990 (Figure 3). As reported by Lyons (1990) the steadily increased spring flow at Sadlerochit Springs suggested that the trend in 1989 was toward a wetter then normal year. In 1990 the steady decrease in flow from Sadlerochit Springs indicates a trend towards a relatively drier than normal year.

Due to the extreme conditions that exist prior to and during breakup, discharge measurements can not be taken until the river channel is free of anchor ice. This accounts for the poor documentation of discharge during the breakup period.

Estimates of missing data have been made where a strong relationship between two streams was found. As additional data is collected these

relationships should improve and missing discharge records may be estimated.

The closest river with a long record of discharge measurements is the Sagavanirktok River. The Sadlerochit and Tamayariak Rivers are the largest rivers with gaging stations in the 1002 area. A comparison of the average daily discharge of the Sadlerochit (R^2=0.48) and Tamayariak (R^2=0.22) Rivers to the Sagavanirktok River for 1988, 1989, and 1990 were unsuccessful. The Sagavanirktok River is a much larger drainage system then any within the 1002 area and a strong correlation was not expected.

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Appendix A

Surface Water Discharge Records

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

LOCATION.--Lat 60°49'58", long 143°46'50", in center sec. 36, T.6N., R.33E., 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--97.1 mi^2, of which 66.0 mi^2 is located within the Arctic National Wildlife Refuge Wildernes Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,703 cfs Aug. 20, 1989 @ 2350 hrs; Minimum Discharge, 0.7 cfs Aug. 18, 1990 @ 0903 hrs.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	8.9	2358	10.8	0858	8.1
14	10.8	1718	11.9	0723	9.8
15	10.3	2038	12.4	0938	9.4
16	9.4	2203	10.3	1208	8.9
17	14.1	2358	39.4	0518	9.8
18	47.7	0958	50.3	0003	39.4
19	44.0	0008	46.5	2358	41.7
20	133.9	0733	215.2	0438	38.3
21	117.8	0813	129.2	2353	101.0
22	99.0	0943	107.1	2358	87.6
23	64.3	0003	87.6	2358	50.3
24	46.5	0003	50.3	2353	42.9
25	35.1	0003	42.9	2358	27.4
26	22.4	0003	27.4	2353	17.3
27	15.3	0013	18.0	2353	13.0
28	11.3	0003	13.0	2348	9.8
29	8.5	0013	9.8	2358	7.6
30	6.9	0003	7.6	2353	5.8
TOTAL	706.4		- - -		- - -
AVERAGE	39.2		49.4		29.3
MAXIMUM	133.9		215.2		101.0
MINIMUM	6.9		7.6		5.8
ACRE FT	1398.6		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	5.8	1808	6.1	1128	5.4
2	5.1	1433	5.8	2353	4.5
3	4.2	0008	4.5	2348	3.4
4	3.0	0008	3.4	2353	2.8
5	2.4	0008	2.8	2358	2.0
6	1.7	0003	2.0	2353	1.6
7	1.4	0033	1.6	2018	1.2
8	1.4	1743	1.6	0003	1.3
9	1.6	2023	1.8	0203	1.6
10	1.8	2353	2.2	0248	1.7
11	2.4	1733	2.4	0003	2.2
12	2.4	1628	2.8	0328	2.0
13	2.2	0043	2.6	2358	1.8
14	1.7	0003	1.8	2353	1.6
15	1.4	0018	1.6	2358	1.3
16	1.1	0023	1.3	1508	1.1
17	1.6	2208	1.8	0003	1.2
18	1.7	1908	1.8	0508	1.7
19	1.6	0153	1.7	2208	1.6
20	1.6	0123	1.6	1548	1.4
21	1.4	2358	1.8	1513	1.3
22	3.2	1748	4.2	0003	1.8
23	2.8	0003	3.9	2358	2.0
24	1.6	0008	2.0	2348	1.3
25	1.3	0003	1.4	2358	1.1
26	1.1	0908	1.2	0348	1.1
27	1.0	0003	1.1	2058	1.0
28	4.5	1648	10.3	0003	1.0
29	8.1	0013	9.4	2353	6.5
30	5.4	0003	6.5	2353	4.5
31	3.9	0003	4.5	2358	3.4
TOTAL	80.2		- - -		- - -
AVERAGE	2.6		3.1		2.1
MAXIMUM	8.1		10.3		6.5
MINIMUM	1.0		1.1		1.0
ACRE FT	158.7		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

AUGUST 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	3.0	0003	3.4	2353	2.6
2	2.4	0013	2.8	2358	2.0
3	1.8	0003	2.0	2223	1.7
4	1.7	0018	1.8	2348	1.6
5	1.6	1708	1.7	2348	1.4
6	1.4	1723	1.7	0238	1.3
7	1.7	1913	2.0	0018	1.6
8	1.6	0013	1.7	2353	1.4
9	1.3	0018	1.4	2333	1.3
10	1.2	1903	1.3	2358	1.2
11	1.1	0003	1.2	2348	1.1
12	1.0	0003	1.1	2338	1.0
13	1.0	1738	1.1	2313	0.9
14	0.9	1843	1.0	2358	0.9
15	0.9	1833	1.0	2328	0.8
16	0.8	0008	0.9	2258	0.8
17	0.8	1753	0.9	2353	0.8
18	1.2	2358	5.1	0903	0.7
19	5.1	1303	5.4	2343	4.8
20	4.5	2343	4.8	1543	4.5
21	4.8	1738	5.1	0008	4.8
22	4.8	1603	5.1	0123	4.8
23	4.8	0413	4.8	2243	4.5
24	3.9	0003	4.5	2358	3.2
25	3.0	0003	3.2	2353	2.6
26	2.4	0038	2.6	2343	2.2
27	2.0	0038	2.2	1448	1.8
28	2.4	2343	4.8	1743	2.0
29	9.4	1753	11.9	0003	5.1
30	10.3	0008	10.8	1243	9.8
31	11.3	2358	14.7	0913	10.8
TOTAL	94.1		- - -		- - -
AVERAGE	3.0		3.6		2.7
MAXIMUM	11.3		14.7		10.8
MINIMUM	0.8		0.9		0.7
ACRE FT	186.2		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

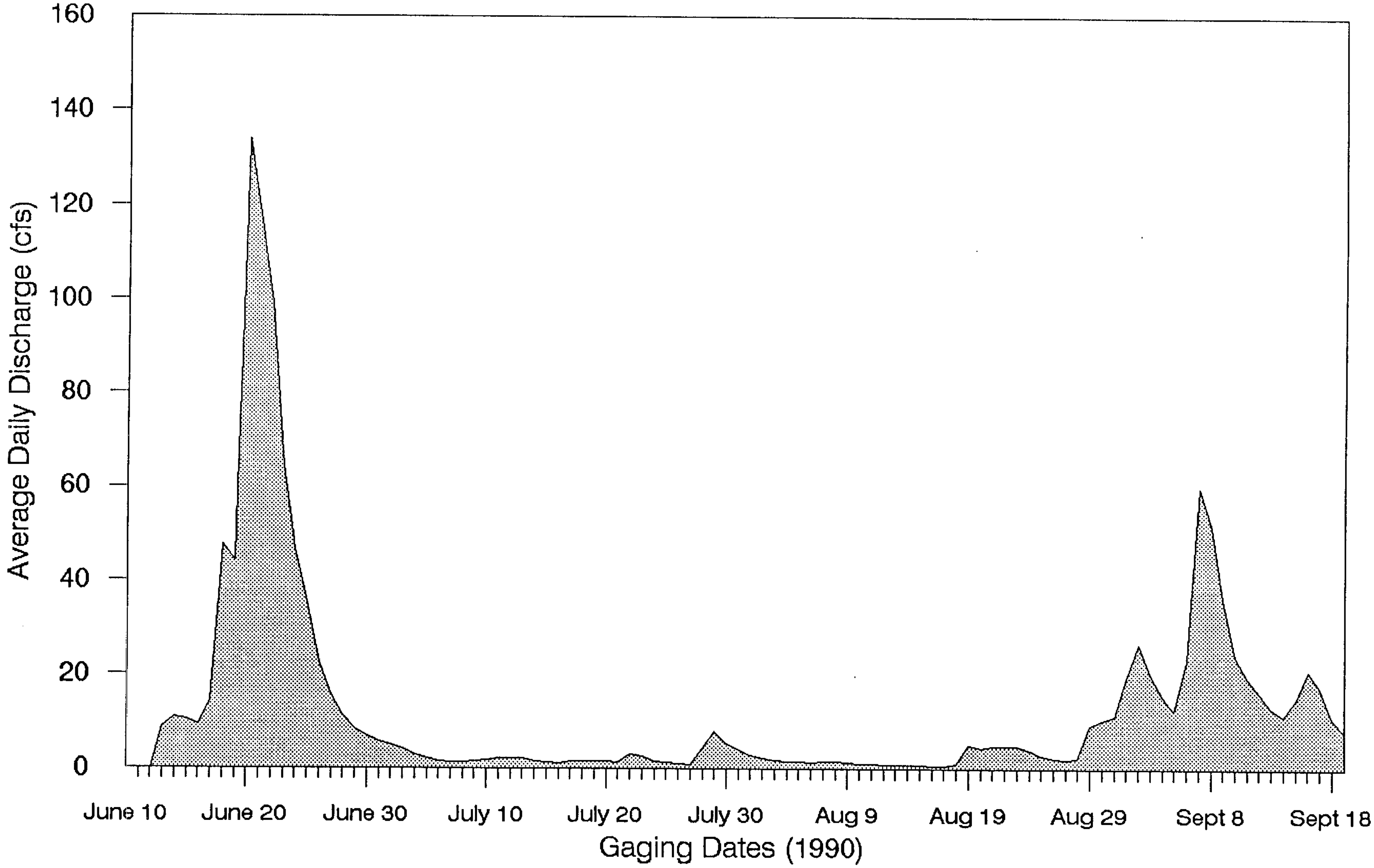
Akutoktak River

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	19.4	2353	29.2	0003	15.3
2	26.5	0008	30.2	2358	23.2
3	20.1	0003	23.2	2358	16.6
4	15.3	0003	16.6	0548	13.0
5	12.4	0003	14.1	0958	10.8
6	23.2	2353	44.0	0033	12.4
7	59.8	1108	70.5	0003	44.0
8	51.6	0313	61.3	2243	41.7
9	36.2	0048	42.9	2238	29.2
10	24.0	0058	30.2	2353	18.0
11	19.4	0838	24.0	2353	14.1
12	16.0	1018	19.4	0213	13.5
13	13.0	0003	14.1	2358	11.9
14	11.3	2358	13.0	1033	9.4
15	14.7	2358	18.7	0003	13.0
16	20.8	1723	24.0	0008	18.7
17	17.3	0003	20.1	2358	13.0
18	10.8	1553	13.5	1028	8.5
19	8.1	0003	9.4	2343	6.9
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	419.9		- - -		- - -
AVERAGE	22.1		27.3		17.5
MAXIMUM	59.8		70.5		44.0
MINIMUM	8.1		9.4		6.9
ACRE FT	831.4		- - -		- - -

Akutotak River

1990



ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

LOCATION.--Lat 69°50'19", long 144°24'43", NE¼NW¼NW¼ sec. 33, T.6N., R.31E., 0.6 miles upstream from the confluence with the Itkilyariak Creek, 20.75 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--26.9 mi², of which 8.7 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 3rd Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,419 cfs Aug. 20, 1989 @ 1825 hrs; Minimum Discharge, 0 cfs July 2-6, 1989, and July 13-16, 1990.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	43.0	2344	112.6	0009	25.3
13	80.6	0054	127.2	1144	56.1
14	47.1	0004	78.6	1624	34.1
15	28.5	0034	43.0	1909	22.4
16	31.8	0334	48.6	0004	22.4
17	26.4	1954	36.5	0619	20.6
18	29.5	2359	59.3	1624	24.3
19	66.0	2349	159.6	1249	45.7
20	88.5	0054	156.8	2354	53.0
21	44.3	0114	57.7	1624	37.8
22	53.0	0249	73.0	2359	37.8
23	29.5	0004	39.0	2359	23.4
24	19.7	0009	23.4	2349	15.6
25	12.0	0004	15.6	2354	10.1
26	7.8	0009	10.1	2359	7.3
27	6.8	0004	7.3	0724	6.3
28	5.8	0004	6.8	2344	5.4
29	4.9	0004	5.4	1739	4.5
30	5.4	1734	5.8	0029	4.9
TOTAL	630.4		- - -		- - -
AVERAGE	33.2		56.1		24.0
MAXIMUM	88.5		159.6		56.1
MINIMUM	4.9		5.4		4.5
ACRE FT	1248.2		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	4.5	0004	5.4	2359	4.1
2	3.4	0009	4.1	1619	3.4
3	3.0	2124	3.7	1414	2.7
4	2.7	0004	3.7	2334	2.4
5	2.1	0004	2.4	2354	1.6
6	1.4	0004	1.6	2029	1.2
7	1.4	1714	1.6	1314	1.2
8	1.9	2309	2.7	0059	1.4
9	2.1	0014	2.7	2354	1.6
10	1.6	0024	1.9	2354	1.4
11	1.0	0034	1.4	2354	0.8
12	0.5	0009	0.8	2344	0.3
13	0.1	0009	0.3	2359	0.0
14	0.0	2224	0.1	0644	0.0
15	0.1	1149	0.1	2334	0.0
16	1.0	1449	1.4	0004	0.0
17	1.2	2154	1.4	0304	0.8
18	1.4	1714	1.9	0514	1.2
19	1.4	0004	1.6	2359	1.0
20	0.6	0004	1.0	2359	0.5
21	0.8	2359	4.1	0719	0.3
22	20.6	1144	47.1	0004	4.5
23	25.3	0019	29.5	2354	20.6
24	15.6	0009	19.7	2354	11.3
25	9.5	0004	11.3	2049	8.9
26	48.6	1849	115.0	0009	10.1
27	41.6	0009	82.5	2344	23.4
28	16.4	0014	23.4	2344	12.7
29	11.3	0014	12.7	2359	10.1
30	8.9	0004	10.1	2339	7.8
31	6.8	0004	7.8	2359	5.8
TOTAL	236.6		- - -		- - -
AVERAGE	7.6		13.0		4.5
MAXIMUM	48.6		115.0		23.4
MINIMUM	0.0		0.1		0.0
ACRE FT	468.4		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

AUGUST 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	5.4	0004	5.8	2359	4.5
2	3.7	0029	4.5	2354	3.0
3	3.0	1429	3.0	0624	2.7
4	4.9	1914	8.3	0004	2.7
5	6.8	0119	7.8	2344	5.4
6	4.9	0009	5.8	2344	3.7
7	3.7	0009	4.1	2354	3.4
8	3.4	1649	3.4	0619	3.0
9	3.0	1219	3.4	2359	3.0
10	2.7	0004	3.0	2349	2.7
11	2.4	1534	2.7	2349	2.4
12	2.1	1539	2.4	2359	1.9
13	1.9	1529	2.1	2344	1.6
14	1.6	1524	1.9	2244	1.4
15	1.6	1749	1.9	0629	1.4
16	4.1	1524	4.9	0029	1.6
17	4.5	1519	4.9	2339	4.1
18	3.7	0004	4.1	2324	3.7
19	3.7	1454	4.5	2359	3.7
20	3.7	1719	4.1	0344	3.7
21	4.1	1829	4.9	0744	3.7
22	3.7	0009	4.1	2359	3.4
23	3.0	0009	3.4	2319	2.4
24	2.1	0054	2.4	2319	1.9
25	1.6	0029	1.9	2349	1.2
26	1.2	1434	1.4	2324	1.2
27	1.4	2359	10.1	0809	1.0
28	20.6	1159	28.5	0004	10.1
29	14.8	0009	20.6	2349	12.0
30	12.7	1529	13.4	0534	11.3
31	18.8	2354	26.4	0014	12.7
TOTAL	155.3		- - -		- - -
AVERAGE	5.0		6.4		3.9
MAXIMUM	20.6		28.5		12.7
MINIMUM	1.2		1.4		1.0
ACRE FT	307.5		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

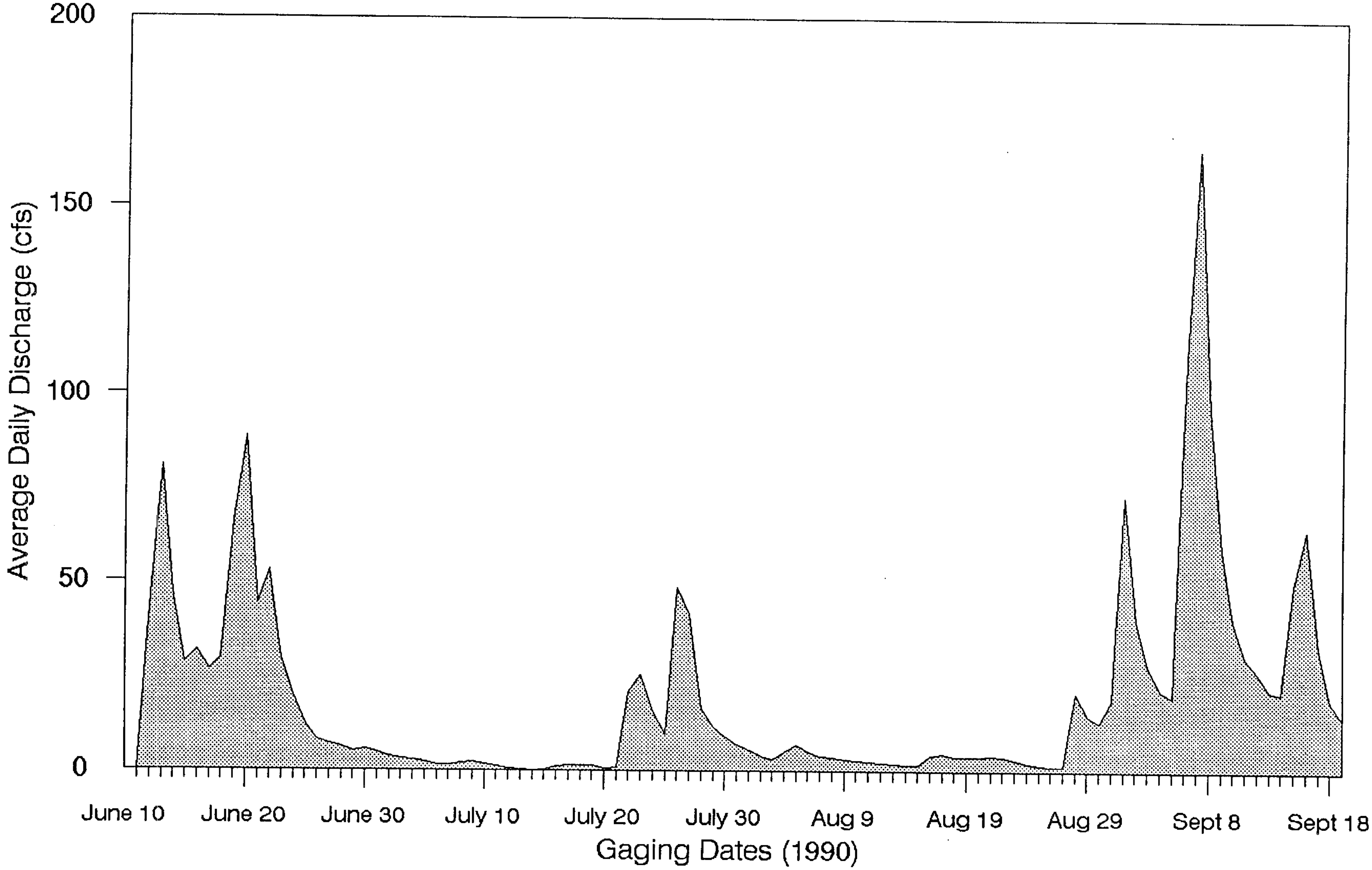
Itkilyariak Creek, West Fork

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	73.0	0314	112.6	0004	26.4
2	40.3	0039	53.0	2334	34.1
3	28.5	0019	35.3	1139	21.5
4	21.5	0029	27.4	1449	18.0
5	19.7	2359	22.4	0629	18.0
6	110.3	2134	288.6	0019	21.5
7	165.5	0019	268.4	2159	124.7
8	96.9	0339	134.9	2359	76.8
9	59.3	0009	78.6	2359	50.0
10	40.3	1844	57.7	0839	27.4
11	30.6	0004	44.3	0929	20.6
12	26.4	0004	36.5	0934	21.5
13	21.5	0009	25.3	0854	18.8
14	20.6	0004	21.5	0849	19.7
15	50.0	2319	96.9	0024	20.6
16	64.2	0054	96.9	2239	47.1
17	32.9	0014	48.6	1339	22.4
18	18.8	0004	30.6	1114	14.8
19	14.1	0009	19.7	1839	11.3
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	934.4		- - -		- - -
AVERAGE	49.2		78.9		32.4
MAXIMUM	165.5		288.6		124.7
MINIMUM	14.1		19.7		11.3
0 ACRE FT	1850.2		- - -		- - -

West Fork Itkilyariak Creek

1990



ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

LOCATION.--Lat 70°0'35", Long 143°1'54", NW¼NW¼NE¼ sec. 36, T.8N., R.36E., 6 miles upstream from the mouth, 16.5 mi south-east of Kaktovik, Alaska.

DRAINAGE AREA.--136.2 mi^2.

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year. Bear disturbed instrument July 13, 1990.

EXTREMES FOR PERIOD OF RECORD.-Maximum Discharge, 2,071 cfs Aug. 21, 1989 @ 0310 hrs; Minimum Discharge, 3.0 cfs July 8, 1990.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	71	2351	92	0001	58
11	87	0556	102	2356	75
12	78	2356	121	1041	66
13	135	0551	156	1651	112
14	138	0351	168	1641	110
15	138	0441	171	1606	110
16	107	0311	143	1826	82
17	92	0501	99	1756	85
18	94	0611	107	1756	85
19	89	0346	104	1616	80
20	92	2356	110	1341	80
21	92	0206	115	1621	75
22	94	0411	112	1526	80
23	94	0331	118	1941	78
24	64	0106	85	1901	52
25	52	0626	58	1756	44
26	48	0636	58	2216	37
27	34	0001	39	2021	29
28	34	1021	37	1741	27
29	32	0956	35	2111	29
30	26	0326	30	2101	20
TOTAL	1689		- - -		- - -
AVERAGE	80		98		67
MAXIMUM	138		171		112
MINIMUM	26		30		20
ACRE FT	3345		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	21	701	22	2131	18
2	17	0901	6	2321	4
3	14	1126	11	2251	3
4	13	1651	4	0311	3
5	8 e	- - -	- - -	- - -	- - -
6	5 e	- - -	- - -	- - -	- - -
7	5 e	- - -	- - -	- - -	- - -
8	3 e	- - -	- - -	- - -	- - -
9	5 e	- - -	- - -	- - -	- - -
10	4 e	- - -	- - -	- - -	- - -
11	4 e	- - -	- - -	- - -	- - -
12	3 e	- - -	- - -	- - -	- - -
13	2 e	- - -	- - -	- - -	- - -
14	2 e	- - -	- - -	- - -	- - -
15	1 e	- - -	- - -	- - -	- - -
16	1 e	- - -	- - -	- - -	- - -
17	2 e	- - -	- - -	- - -	- - -
18	2 e	- - -	- - -	- - -	- - -
19	1 e	- - -	- - -	- - -	- - -
20	1 e	- - -	- - -	- - -	- - -
21	1 e	- - -	- - -	- - -	- - -
22	5 e	- - -	- - -	- - -	- - -
23	6 e	- - -	- - -	- - -	- - -
24	2 e	- - -	- - -	- - -	- - -
25	1 e	- - -	- - -	- - -	- - -
26	1 e	- - -	- - -	- - -	- - -
27	1 e	- - -	- - -	- - -	- - -
28	1 e	- - -	- - -	- - -	- - -
29	1 e	- - -	- - -	- - -	- - -
30	1 e	- - -	- - -	- - -	- - -
31	1 e	- - -	- - -	- - -	- - -
TOTAL	135		- - -		- - -
AVERAGE	4		- - -		- - -
MAXIMUM	21		- - -		- - -
MINIMUM	1		- - -		- - -
ACRE FT	278		- - -		- - -

NOTE: e = estimated

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

AUGUST 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	1 e	- - -	- - -	- - -	- - -
2	0 e	- - -	- - -	- - -	- - -
3	1 e	- - -	- - -	- - -	- - -
4	1 e	- - -	- - -	- - -	- - -
5	1 e	- - -	- - -	- - -	- - -
6	1 e	- - -	- - -	- - -	- - -
7	0 e	- - -	- - -	- - -	- - -
8	1 e	- - -	- - -	- - -	- - -
9	1 e	- - -	- - -	- - -	- - -
10	0 e	- - -	- - -	- - -	- - -
11	0 e	- - -	- - -	- - -	- - -
12	0 e	- - -	- - -	- - -	- - -
13	0 e	- - -	- - -	- - -	- - -
14	0 e	- - -	- - -	- - -	- - -
15	0 e	- - -	- - -	- - -	- - -
16	0 e	- - -	- - -	- - -	- - -
17	0 e	- - -	- - -	- - -	- - -
18	0 e	- - -	- - -	- - -	- - -
19	0 e	- - -	- - -	- - -	- - -
20	0 e	- - -	- - -	- - -	- - -
21	0 e	- - -	- - -	- - -	- - -
22	0 e	- - -	- - -	- - -	- - -
23	0 e	- - -	- - -	- - -	- - -
24	0 e	- - -	- - -	- - -	- - -
25	0 e	- - -	- - -	- - -	- - -
26	0 e	- - -	- - -	- - -	- - -
27	0 e	- - -	- - -	- - -	- - -
28	1 e	- - -	- - -	- - -	- - -
29	1 e	- - -	- - -	- - -	- - -
30	1 e	- - -	- - -	- - -	- - -
31	3 e	- - -	- - -	- - -	- - -
TOTAL	16		- - -		- - -
AVERAGE	1		- - -		- - -
MAXIMUM	1		- - -		- - -
MINIMUM	0		- - -		- - -
ACRE FT	31		- - -		- - -

NOTE: e = estimated

ARCTIC NATIONAL WILDLIFE REFUGE

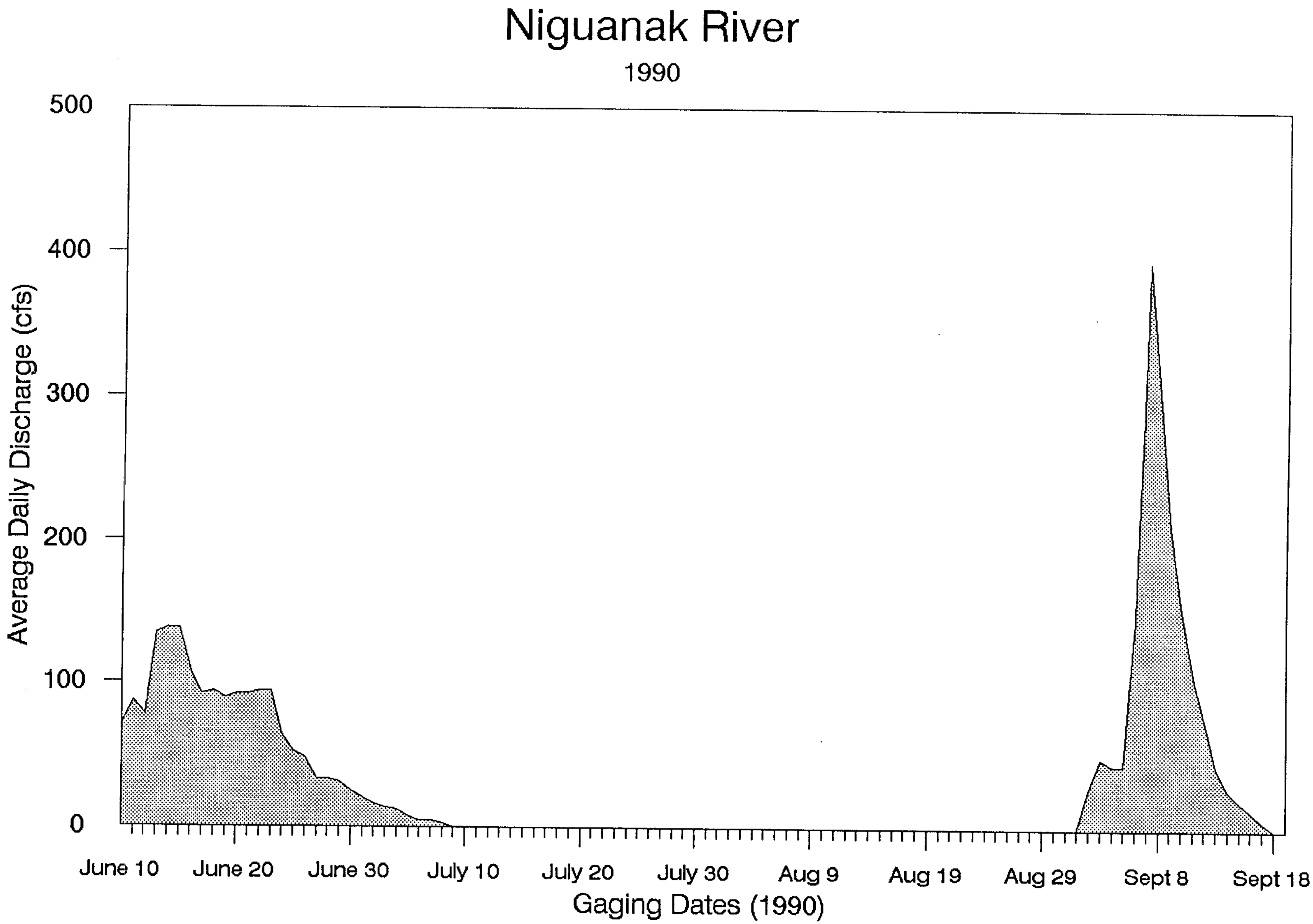
Niguanak River

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	16 e	- - -	- - -	- - -	- - -
2	29 e	- - -	- - -	- - -	- - -
3	39 e	- - -	- - -	- - -	- - -
4	37 e	- - -	- - -	- - -	- - -
5	37 e	- - -	- - -	- - -	- - -
6	84 e	- - -	- - -	- - -	- - -
7	200 e	- - -	- - -	- - -	- - -
8	155 e	- - -	- - -	- - -	- - -
9	115 e	- - -	- - -	- - -	- - -
10	87 e	- - -	- - -	- - -	- - -
11	66 e	- - -	- - -	- - -	- - -
12	50 e	- - -	- - -	- - -	- - -
13	37 e	- - -	- - -	- - -	- - -
14	29 e	- - -	- - -	- - -	- - -
15	25 e	- - -	- - -	- - -	- - -
16	22 e	- - -	- - -	- - -	- - -
17	19 e	- - -	- - -	- - -	- - -
18	16 e	- - -	- - -	- - -	- - -
19	13 e	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -

TOTAL	1076
AVERAGE	57
MAXIMUM	200
MINIMUM	13
ACRE FT	2130

NOTE: e = estimated



Niguanak River
1990
Average Daily Discharge (cfs)
0
100
200
300
400
500
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

LOCATION.--Lat 69°38′, long 144° 22′50″, in NW¼SW¼ sec. 31, T.4N., R.32E., 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.--520.1 mi^2, of which 517.5 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi^2 depending on existing climatic conditions.

PERIOD OF RECORD.-- July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 5,733 cfs Aug. 4, 1989 @ 1545 hrs; Minimum Discharge, 70 cfs Sept. 27, 1988 @ 1145 hrs.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	177	1842	186	0412	167
12	200	1102	215	0027	177
13	459	2357	618	0002	209
14	557	2357	740	1747	447
15	1065	2347	3951	1812	732
16	2578	0152	4360	1732	1605
17	1889	0542	2618	1942	1391
18	2678	0537	4857	0027	1842
19	2052	2327	4502	1657	1495
20	2520	0022	4589	2357	1563
21	1328	2357	1827	1732	1152
22	1550	0252	1953	2352	1220
23	1086	0032	1244	2142	954
24	869	0027	983	2217	748
25	740	0732	781	2107	685
26	773	0532	833	0002	708
27	896	2357	1378	0012	773
28	1550	1257	2189	0447	1197
29	1634	2357	2296	2037	1316
30	2069	0352	2992	2317	1550
TOTAL	26668		- - -		- - -
AVERAGE	1333		2156		997
MAXIMUM	2678		4857		1842
MINIMUM	177		186		167
ACRE FT	52803		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	1416	0027	1605	2137	1244
2	1255	0652	1403	2342	1130
3	1119	0902	1186	1947	1055
4	1055	0242	1130	2147	973
5	983	0802	1024	2157	925
6	954	0842	993	2242	915
7	944	0932	993	2212	887
8	887	0752	925	2247	833
9	798	0322	851	2332	748
10	756	1127	790	2217	708
11	708	0812	732	2352	670
12	700	0957	732	0102	670
13	781	1137	860	0022	677
14	993	1557	1108	0002	842
15	1267	0627	1482	0002	1086
16	1044	0457	1130	2217	934
17	896	0112	944	2357	833
18	815	0017	851	2317	773
19	764	0642	798	2342	716
20	732	0652	773	2337	685
21	748	2352	815	0012	685
22	1429	1732	1677	0002	824
23	1429	0102	1522	2352	1340
24	1174	0017	1365	2302	1034
25	983	0342	1044	2022	925
26	1044	1402	1108	0017	944
27	896	0022	1013	2352	773
28	708	0002	781	2327	647
29	633	0742	655	2352	590
30	670	0712	756	0132	590
31	647	0717	685	2342	597
TOTAL	29232		- - -		- - -
AVERAGE	943		1024		847
MAXIMUM	1429		1677		1340
MINIMUM	633		655		590
ACRE FT	57879		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

AUGUST 1990

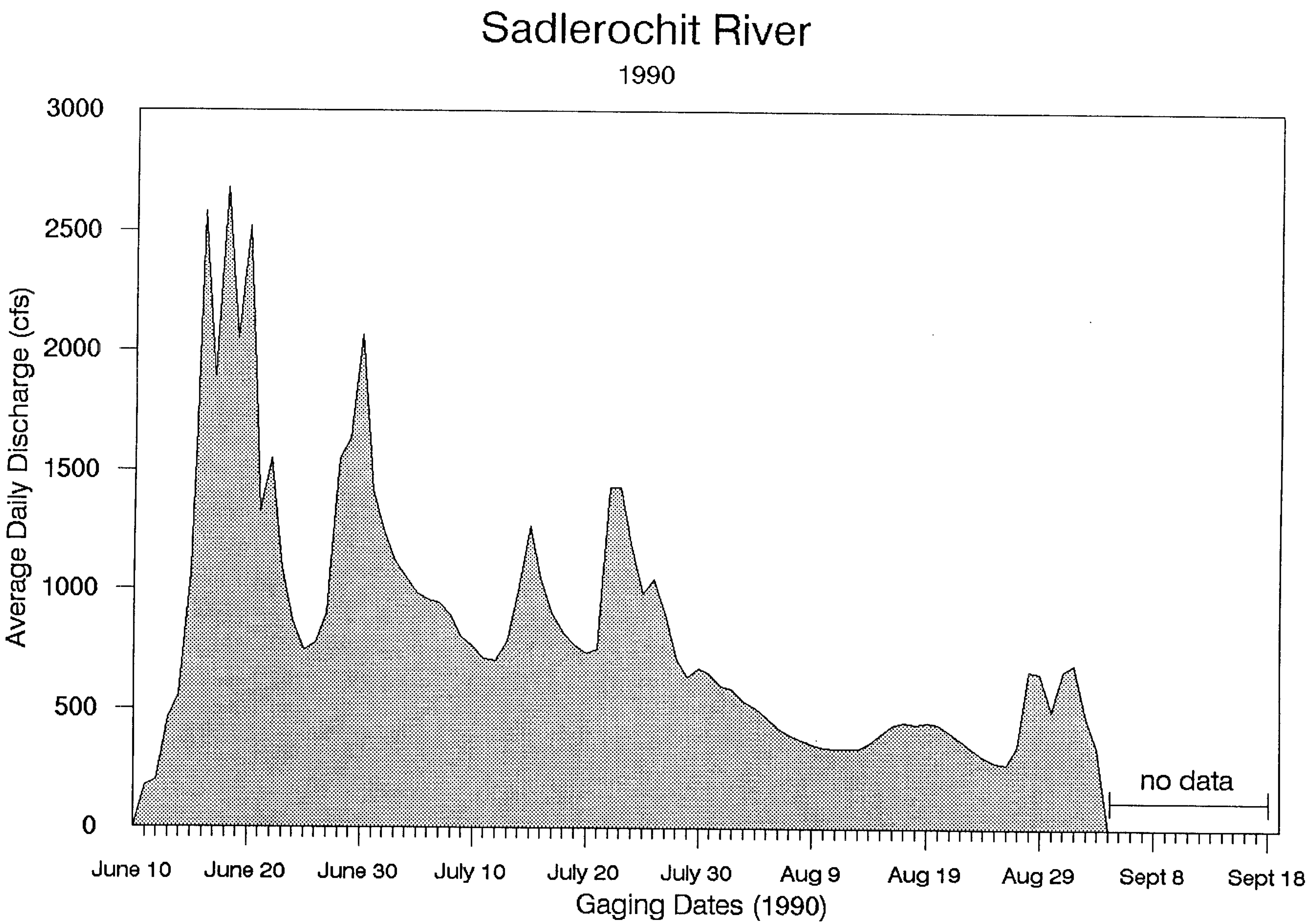
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	597	1002	625	2247	577
2	584	1127	625	2357	550
3	537	0002	550	2247	525
4	506	0147	531	2247	482
5	470	0047	488	2327	442
6	426	0017	442	2327	399
7	394	0312	405	2317	374
8	374	0012	379	2252	360
9	355	1457	370	2352	341
10	341	1532	351	2357	332
11	337	1807	346	0632	328
12	337	1407	355	0427	324
13	337	1632	355	0552	319
14	360	1252	384	0127	328
15	399	1132	420	0047	370
16	436	1147	494	0042	389
17	447	1312	464	2357	426
18	442	1537	453	0257	426
19	447	1207	459	2352	436
20	442	1432	459	2357	426
21	410	0027	431	2347	389
22	374	0007	389	2347	355
23	337	0002	355	2312	319
24	307	0007	319	2332	290
25	282	0002	294	2332	271
26	271	2117	275	0442	267
27	351	2352	597	0252	263
28	662	2247	708	0007	590
29	655	0407	740	2342	557
30	500	0012	557	2107	464
31	662	1052	716	0007	482
TOTAL	13381		- - -		- - -
AVERAGE	432		462		400
MAXIMUM	662		740		590
MINIMUM	271		275		263
ACRE FT	26493		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	692	0542	807	2322	570
2	476	0042	577	2352	410
3	346	0032	410	1517	311
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	- - -		- - -		- - -
AVERAGE	- - -		- - -		- - -
MAXIMUM	- - -		- - -		- - -
MINIMUM	- - -		- - -		- - -
ACRE FT	- - -		- - -		- - -


Sadlerochit River
1990
Average Daily Discharge (cfs)
3000
2500
2000
1500
1000
500
0
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)
no data

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

LOCATION.--Lat 69°39'53", long 144°24'52", NE¼NW¼ sec. 36, T.4N., R.31E., 3000 ft. downstream of Sadlerochit Spring, 37.5 mi. southwest of Kaktovik, Alaska.

DRAINAGE AREA.--0.5 mi^2.

PERIOD OF RECORD.--July to Dec. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 2nd Order drainage with 2 springs contributing most of the flow.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 108 cfs Aug. 20, 1989 @ 1345 hrs; Minimum Discharge, 28 cfs Aug. 15, 1988 @ 1815 hrs.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	39	2042	40	0027	38
12	40	0352	40	1247	39
13	40	0937	40	1552	40
14	40	0712	40	1522	40
15	40	0757	40	1327	40
16	40	0917	40	1347	40
17	40	1022	40	0232	40
18	40	1707	41	1202	40
19	40	0017	41	1512	40
20	40	0117	40	1922	40
21	40	1637	40	0017	40
22	40	0907	40	1617	40
23	40	1047	40	1922	40
24	40	1007	40	1822	40
25	40	0917	40	1847	40
26	40	0752	40	2012	40
27	40	0242	40	1507	40
28	40	0852	40	1837	40
29	40	0802	40	2232	40
30	40	0907	40	2257	39
TOTAL	800		- - -		- - -
AVERAGE	40		40		40
MAXIMUM	40		41		40
MINIMUM	39		40		38
ACRE FT	1584		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	40	0527	40	1847	39
2	39	0117	40	2337	39
3	39	0907	40	0337	39
4	39	0957	39	1332	39
5	39	2022	39	1052	39
6	39	0502	40	1742	39
7	39	0322	39	1827	39
8	39	0352	39	1742	39
9	38	0057	39	2102	38
10	38	0512	38	2357	35
11	36	2347	36	0032	35
12	36	0307	36	1942	36
13	36	2232	37	1922	36
14	36	2247	37	0817	36
15	36	0007	37	1912	36
16	36	0702	37	1342	36
17	36	0252	36	1937	36
18	36	0507	36	1342	36
19	36	1742	37	1227	36
20	36	0642	36	1227	36
21	36	1012	36	1727	36
22	36	0352	36	2147	36
23	37	1407	37	0027	36
24	37	0352	37	1702	36
25	37	0842	37	1852	36
26	36	0532	37	2152	36
27	36	0512	37	2117	36
28	36	0707	37	1747	36
29	36	0832	37	2037	36
30	36	0552	37	1707	36
31	36	0512	36	2232	36
TOTAL	1152		- - -		- - -
AVERAGE	37		37		37
MAXIMUM	40		40		39
MINIMUM	36		36		35
ACRE FT	2281		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

AUGUST 1990

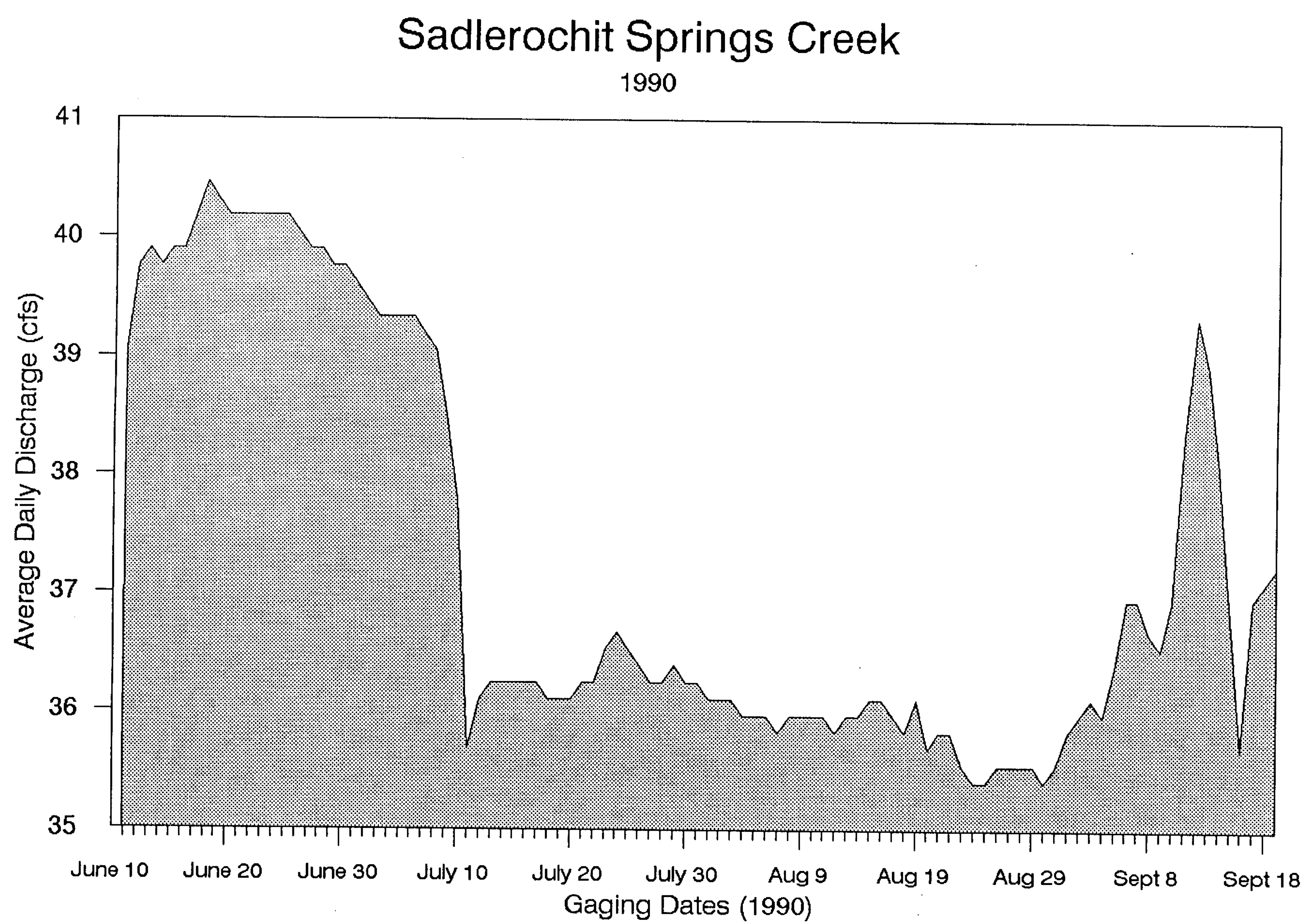
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	36	0612	36	1947	36
2	36	0547	36	1412	36
3	36	0627	36	2157	36
4	36	0427	36	1927	36
5	36	0332	36	1612	36
6	36	0432	36	1617	36
7	36	0612	36	1722	36
8	36	0537	36	1617	36
9	36	0522	36	1807	36
10	36	0037	36	1632	36
11	36	0512	36	1642	36
12	36	0012	36	1732	36
13	36	0502	36	1437	36
14	36	0652	36	1722	36
15	36	0557	36	1647	36
16	36	0502	36	1627	36
17	36	0527	36	1547	36
18	36	0502	36	1847	36
19	36	1317	36	0112	36
20	36	0437	37	0447	35
21	36	0602	36	1752	36
22	36	0547	36	1607	36
23	36	0507	36	1347	35
24	35	0537	36	1617	35
25	35	0637	36	1517	35
26	36	0552	36	1522	35
27	36	0702	36	1512	35
28	36	0712	36	1702	35
29	36	0727	36	0007	35
30	35	0602	36	1237	35
31	36	1802	36	1102	35
TOTAL	1110		- - -		- - -
AVERAGE	36		36		36
MAXIMUM	36		37		36
MINIMUM	35		36		35
ACRE FT	2199		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	36	0432	36	2022	36
2	36	1327	36	0157	36
3	36	0627	36	1552	36
4	36	0507	36	1737	36
5	36	0612	37	0017	36
6	37	2147	37	0022	36
7	37	0812	37	2242	37
8	37	0147	37	1537	36
9	37	0542	37	1502	36
10	37	2357	40	1542	36
11	38	2007	40	0547	37
12	39	0032	40	2207	39
13	39	1947	39	0857	39
14	38	0022	39	2142	36
15	37	0637	37	2352	35
16	36	0707	37	0042	29
17	37	0337	37	1737	37
18	37	0612	37	1517	37
19	37	0342	38	1317	37
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	703		- - -		- - -
AVERAGE	37		38		36
MAXIMUM	39		40		39
MINIMUM	36		36		29
ACRE FT	1391		- - -		- - -


Sadlerochit Springs Creek
1990
Average Daily Discharge (cfs)
35
36
37
38
39
40
41
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

LOCATION.--Lat 69°54'43", Long 142°30'52", SE¼SE¼ sec. 36, T.7N., R.38E., at confluence with the West Fork Sikrelurak River, 31 mi south-east of Katktovik, Alaska.

DRAINAGE AREA.-74.7 mi².

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 282 cfs Aug. 20 and 21, 1989; Minimum Discharge, 0 cfs August 14-28, 1990.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	29.5	0007	39.3	0627	24.5
12	37.8	2342	61.2	0007	28.2
13	47.1	2142	61.2	0907	37.8
14	45.5	2127	61.2	1057	36.3
15	43.9	0002	57.5	1137	34.9
16	34.9	0002	48.8	1237	28.2
17	30.8	2257	37.8	1317	24.5
18	33.5	2122	42.3	1027	25.7
19	30.8	0007	39.3	1047	24.5
20	33.5	1957	48.8	0937	24.5
21	32.1	2047	42.3	1017	22.2
22	30.8	2032	42.3	1012	21.1
23	29.5	1852	39.3	1052	21.1
24	21.1	0002	32.1	1202	15.9
25	20.0	2107	30.8	1002	14.1
26	16.9	0002	26.9	1057	12.3
27	15.0	2302	23.3	1127	10.7
28	16.9	2102	25.7	1147	10.7
29	15.0	0002	23.3	1152	10.7
30	10.7	0002	15.9	1137	7.8
TOTAL	575.2		- - -		- - -
AVERAGE	28.8		40.0		21.8
MAXIMUM	47.1		61.2		37.8
MINIMUM	10.7		15.9		7.8
ACRE FT	1138.9		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	9.2	0007	14.1	1237	6.5
2	8.5	2152	14.1	1232	5.3
3	8.5	0007	13.2	1452	5.3
4	5.3	0002	9.9	1852	3.8
5	4.3	0052	5.9	2057	2.9
6	3.8	0142	4.8	2112	2.5
7	2.2	0337	3.8	2357	1.2
8	2.9	1532	4.8	0012	1.2
9	2.5	0002	3.3	2357	1.8
10	2.2	1247	2.2	2347	1.8
11	1.8	1547	1.8	2337	1.2
12	1.5	1242	1.8	2352	1.2
13	1.2	1222	1.5	2357	1.0
14	1.0	1527	1.2	2352	0.7
15	0.7	1427	1.0	2347	0.5
16	0.5	1552	0.7	0702	0.4
17	1.0	2017	1.2	0017	0.4
18	1.0	0002	1.0	2342	0.7
19	0.5	0012	0.7	2352	0.5
20	0.4	1447	0.5	2352	0.4
21	0.5	2307	0.7	0322	0.2
22	2.5	1747	3.3	0012	0.7
23	2.9	0007	3.3	2357	1.8
24	1.2	0002	1.8	2337	1.0
25	0.7	0222	1.0	2327	0.5
26	0.7	1022	0.7	2357	0.5
27	0.5	1332	0.7	2357	0.4
28	0.4	1532	0.5	2327	0.4
29	0.4	1322	0.5	0027	0.2
30	0.4	1437	0.5	2352	0.2
31	0.4	1807	0.4	0057	0.2
TOTAL	69.6		- - -		- - -
AVERAGE	2.2		3.3		1.5
MAXIMUM	9.2		14.1		6.5
MINIMUM	0.4		0.4		0.2
ACRE FT	137.7		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

AUGUST 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	0.4	1617	0.4	2357	0.2
2	0.2	1517	0.4	2032	0.1
3	0.4	1337	0.5	0142	0.1
4	0.5	1457	0.7	0812	0.4
5	0.5	1502	0.7	2327	0.4
6	0.4	1512	0.5	2102	0.2
7	0.2	1402	0.5	0722	0.2
8	0.4	2247	0.4	0022	0.2
9	0.4	0047	0.4	2357	0.2
10	0.2	1927	0.2	0347	0.2
11	0.2	1707	0.4	0147	0.2
12	0.2	1547	0.4	0342	0.2
13	0.2	1602	0.4	2357	0.1
14	0.1	1352	0.2	2357	0.0
15	0.1	1537	0.2	0137	0.0
16	0.1	1357	0.2	2332	0.0
17	0.0	1522	0.2	0337	0.0
18	0.0	1757	0.1	0157	0.0
19	0.1	1227	0.2	2342	0.0
20	0.0	1512	0.0	2157	0.0
21	0.0	1457	0.1	2357	0.0
22	0.0	0007	0.0	2347	0.0
23	0.0	1622	0.0	0317	0.0
24	0.0	1622	0.0	0102	0.0
25	0.0	1157	0.0	2247	0.0
26	0.0	2317	0.0	0037	0.0
27	0.0	2322	0.1	1722	0.0
28	0.5	1752	1.0	0012	0.0
29	0.7	1107	1.0	0342	0.5
30	0.7	2357	1.2	0752	0.7
31	1.5	2357	2.9	1837	1.2
TOTAL	8.3		- - -		- - -
AVERAGE	0.3		0.4		0.2
MAXIMUM	1.5		2.9		1.2
MINIMUM	0.0		0.0		0.0
ACRE FT	16.5		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

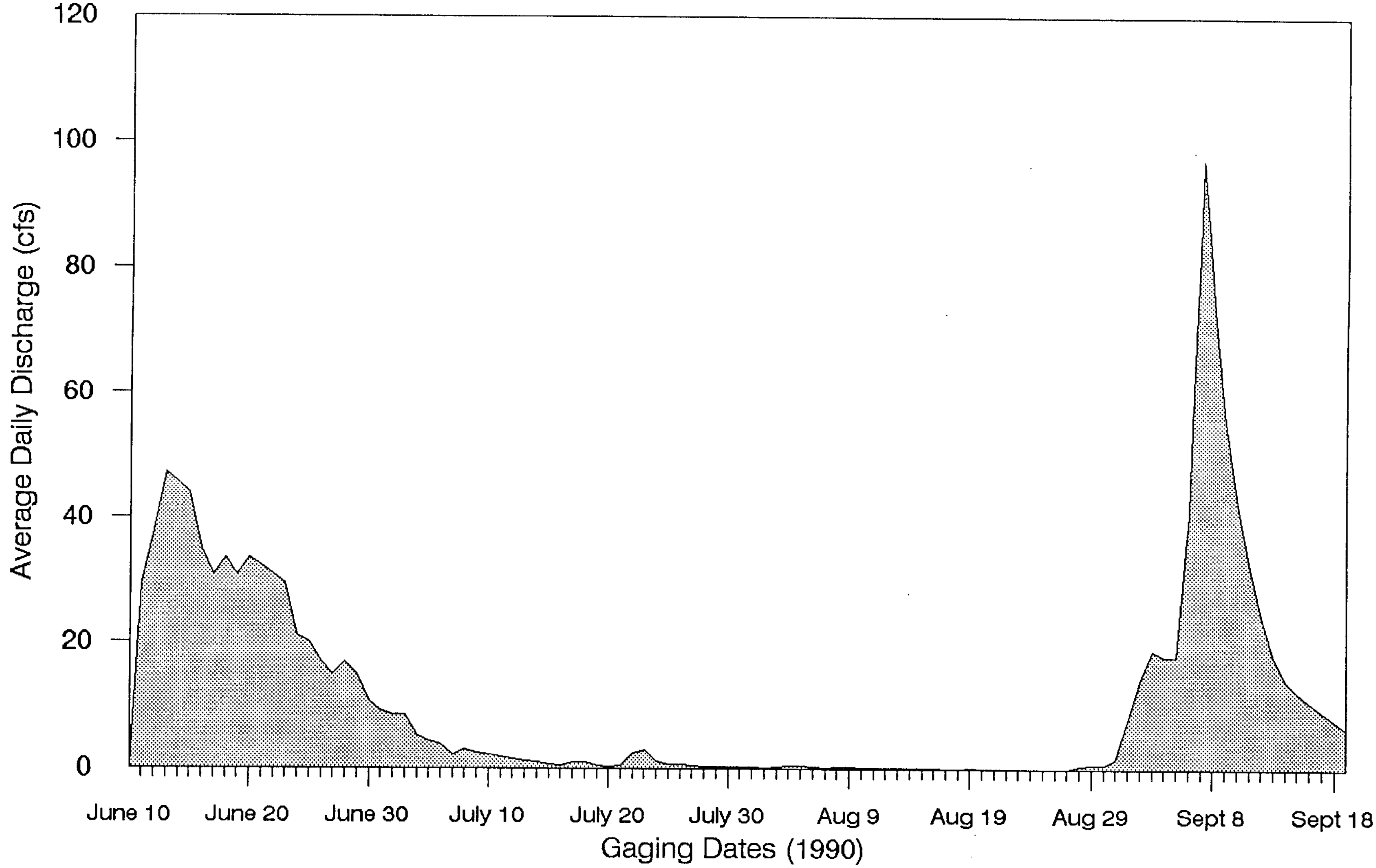
Sikrelurak River

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	7.8	2322	12.3	0002	2.9
2	14.1	2312	16.9	0937	11.5
3	18.9	1402	21.1	0007	16.9
4	17.9	0232	18.9	2202	16.9
5	17.9	2357	18.9	0027	16.9
6	40.8	2357	106.9	0002	18.9
7	97.2	0102	117.1	2257	85.8
8	75.1	0007	90.3	2007	67.0
9	55.7	0007	69.0	2357	48.8
10	42.3	1447	65.0	0857	26.9
11	32.1	1507	50.5	0937	20.0
12	24.5	0017	29.5	0822	18.9
13	17.9	1647	22.2	0807	11.5
14	14.1	0007	15.9	2357	13.2
15	12.3	0012	13.2	2332	11.5
16	10.7	1157	11.5	1017	9.2
17	9.2	0022	9.2	2337	7.8
18	7.8	0832	9.9	2357	6.5
19	6.5	0042	7.1	2237	5.3
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	522.8		- - -		- - -
AVERAGE	27.5		37.1		21.9
MAXIMUM	97.2		117.1		85.8
MINIMUM	6.5		7.1		2.9
ACRE FT	1035.2		- - -		- - -

Sikreluriak River

1990



ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

LOCATION.--Lat 69°49'58", long 145°33'10", in SW¼NE¼ sec. 35, T.6N., R.26E., 11.8 miles upstream from the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--136.1 mi^2, of which 56.8 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,996 ft^3/s Aug. 12, 1988 @ 1445 hrs; Minimum Discharge, 12 ft^3/s Sept. 26, 1988 @ 1300 hrs.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	124	2355	171	2400	107
13	228	2345	300	0010	171
14	260	2350	405	1415	192
15	412	2300	1719	1545	243
16	794	2400	1609	1830	565
17	535	0120	833	2350	428
18	313	2400	428	1615	265
19	228	0005	294	1520	196
20	187	0055	249	1625	160
21	153	0220	187	2010	133
22	136	0235	153	1655	124
23	153	0935	196	2345	133
24	105	2400	133	2125	86
25	93	2355	110	1735	86
26	107	0330	127	1825	93
27	88	0155	102	1535	80
28	130	1545	223	0010	86
29	160	2350	319	1525	121
30	249	0040	326	2340	175
TOTAL	4455		- - -		- - -
AVERAGE	234		415		181
MAXIMUM	794		1719		565
MINIMUM	88		102		80
ACRE FT	8821		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	133	0005	175	2335	102
2	91	0205	105	2315	74
3	69	0345	78	2230	56
4	55	1105	61	2215	48
5	48	0830	53	2210	43
6	44	0805	48	2340	39
7	41	2355	48	0040	39
8	52	0740	55	2400	48
9	48	2400	50	2210	45
10	43	0025	46	2350	39
11	38	0820	40	2355	33
12	33	0840	35	2210	30
13	30	1225	31	1730	29
14	31	2255	32	0005	29
15	33	1025	37	0425	31
16	32	1305	33	2245	30
17	33	2125	35	0020	31
18	33	2400	34	2135	30
19	31	1055	32	2345	29
20	30	1120	31	2110	29
21	33	2355	43	0025	29
22	146	0540	205	2400	43
23	118	0005	136	2355	98
24	86	0005	98	2355	74
25	71	0015	76	2340	64
26	61	0030	64	2015	56
27	67	1155	73	2400	58
28	62	0005	66	2245	56
29	53	0120	56	2350	48
30	45	0015	48	2245	41
31	41	1030	43	2350	38
TOTAL	1731		- - -		- - -
AVERAGE	56		63		46
MAXIMUM	146		205		102
MINIMUM	30		31		29
ACRE FT	3427		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

AUGUST 1990

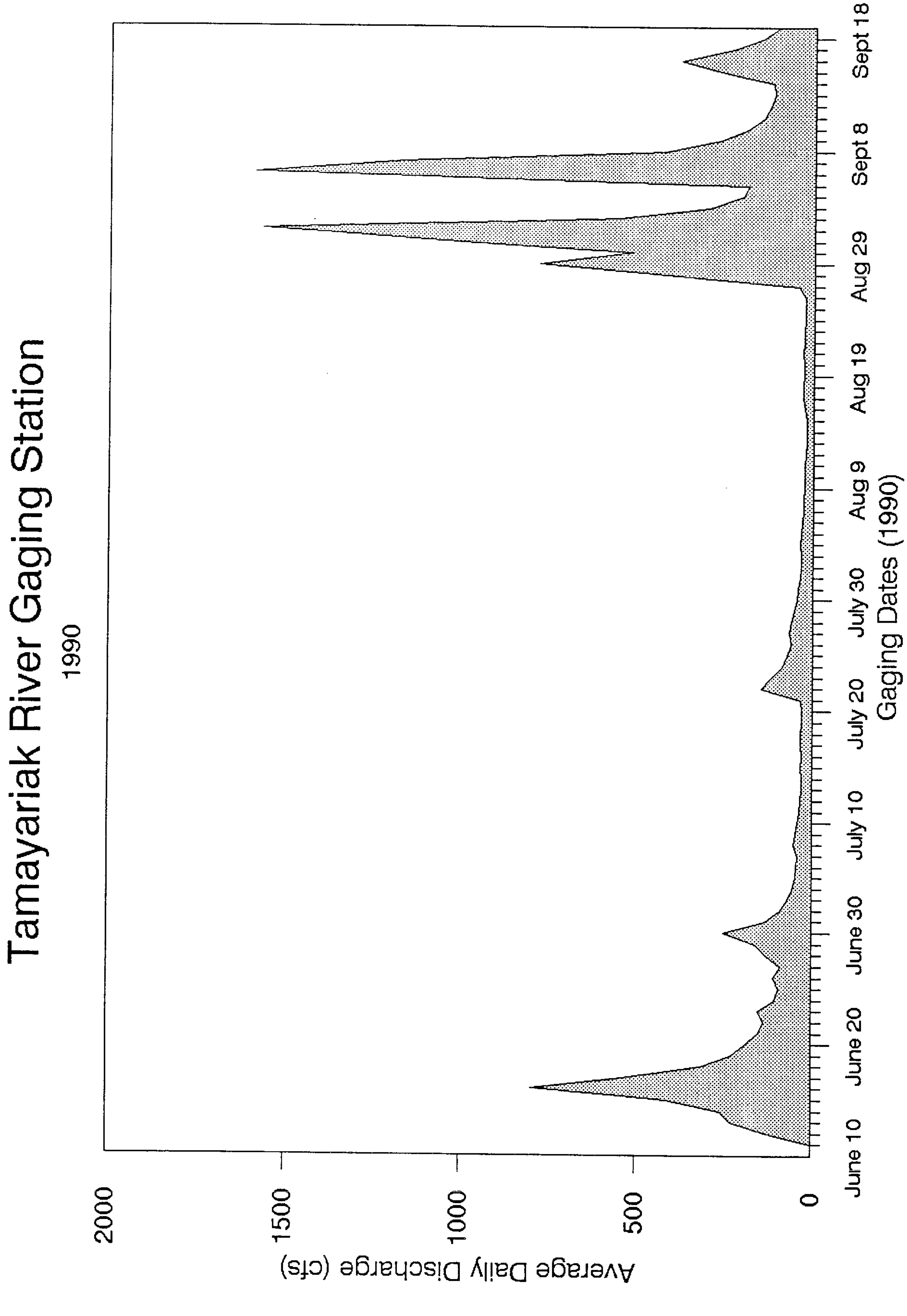
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	38	1130	40	2340	34
2	34	1130	35	2025	32
3	34	2120	35	0020	32
4	35	1050	37	2315	33
5	33	1020	35	2315	29
6	30	0850	32	2120	27
7	29	0935	29	2210	27
8	28	1205	28	2340	27
9	27	1230	28	2215	26
10	27	1225	28	2125	24
11	26	1205	27	2205	23
12	23	1125	26	2305	21
13	21	0910	23	2105	19
14	21	0920	22	2235	19
15	21	0945	22	2055	20
16	26	2350	31	0115	21
17	32	1045	34	2020	29
18	30	1425	31	1955	29
19	29	1145	31	2040	28
20	29	1105	30	0005	28
21	30	1255	31	2350	28
22	29	1015	30	2040	27
23	28	1145	29	2115	26
24	27	1130	28	2335	24
25	24	1050	27	2145	22
26	24	2255	27	1920	23
27	44	2355	102	100	26
28	420	2335	833	2400	102
29	781	0715	874	2355	595
30	516	2350	960	1125	428
31	1100	2355	2004	1900	874
TOTAL	3596		- - -		- - -
AVERAGE	116		179		87
MAXIMUM	1100		2004		874
MINIMUM	21		22		19
ACRE FT	7119		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	1567	0130	2377	2345	846
2	555	10	846	2345	397
3	300	2400	405	2350	260
4	205	0020	260	1850	179
5	187	2355	306	1130	167
6	1588	1850	4099	2400	306
7	1167	0005	2859	2340	616
8	428	0015	638	2350	319
9	271	2400	319	2355	219
10	192	1505	238	0855	160
11	146	0005	175	0800	127
12	127	2400	139	1820	118
13	115	1505	127	1005	102
14	118	2355	133	0745	115
15	260	2345	462	2400	136
16	382	0050	471	2340	332
17	233	0005	332	2350	192
18	149	1735	209	1235	118
19	102	2400	143	1210	73
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	8092		- - -		- - -
AVERAGE	426		765		252
MAXIMUM	1588		4099		846
MINIMUM	102		127		73
ACRE FT	16023		- - -		- - -


Tamayariak River Gaging Station
1990
Average Daily Discharge (cfs)
2000
1500
1000
500
0
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, LOWER WEST FORK

LOCATION.--Lat 69°58'50", long 145°47'40", NW¼NW¼sec 12, T.7N., R.25E., 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--98.14 mi², of which 5.55 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES.--Maximum Discharge, 647 cfs Aug. 21, 1989 @ 0225; Minimum Discharge, 9.0 cfs August 6 & 7, 1988.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	39.6	2313	56.1	0838	34.2
13	46.7	0003	54.9	0838	40.6
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	- - -		- - -		- - -
AVERAGE	- - -		- - -		- - -
MAXIMUM	- - -		- - -		- - -
MINIMUM	- - -		- - -		- - -
ACRE FT	- - -		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, LOWER WEST FORK

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	18.0	1331	19.1	2106	17.5
11	17.5	1616	17.5	2341	16.0
12	16.0	1021	16.5	2226	15.1
13	14.6	0141	15.1	1046	13.7
14	14.2	0021	14.6	2021	12.9
15	13.7	0246	14.6	2356	12.5
16	12.1	1546	12.9	2356	10.9
17	11.7	1206	13.3	0106	10.9
18	11.3	1636	12.1	2351	10.5
19	10.5	1556	11.3	1151	9.8
20	10.1	1431	10.9	0716	9.1
21	10.5	1956	12.5	0451	8.7
22	11.7	0701	12.9	1816	10.1
23	10.1	1616	10.9	1201	9.1
24	8.4	0006	9.4	2111	7.7
25	8.7	1321	9.1	2101	8.0
26	8.0	2006	8.7	1546	7.0
27	7.7	0011	8.4	2351	7.0
28	7.0	1336	7.4	1836	7.0
29	7.0	1226	7.4	1951	6.7
30	6.4	1221	7.0	2211	5.5
31	6.1	0506	6.7	2026	5.5
TOTAL	241.6		- - -		- - -
AVERAGE	11.0		11.7		10.1
MAXIMUM	18.0		19.1		17.5
MINIMUM	6.1		6.7		5.5
ACRE FT	478.3		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, LOWER WEST FORK

AUGUST 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	6.1	0331	6.4	2351	5.8
2	5.8	1546	6.4	1131	5.5
3	5.5	1251	5.8	0531	5.2
4	5.2	1136	5.5	0536	4.6
5	5.2	1531	5.8	2226	4.0
6	4.9	1316	5.2	0001	4.6
7	4.6	0001	4.9	2246	4.0
8	4.6	1316	4.6	0006	4.3
9	4.6	1731	4.9	0346	4.3
10	4.3	1421	4.6	2356	3.7
11	3.7	1606	4.0	1936	3.4
12	3.7	1621	4.0	0521	3.7
13	3.4	0001	3.7	1346	2.8
14	3.4	0331	4.0	1501	2.8
15	3.1	0046	3.7	2101	2.5
16	3.1	0201	3.7	2246	2.8
17	3.1	2356	3.4	1536	2.5
18	3.1	0106	3.7	2346	3.1
19	2.8	1106	3.4	2141	2.5
20	2.8	0146	3.4	2036	2.2
21	2.5	0146	3.1	2151	1.6
22	2.2	0116	3.1	1141	1.6
23	2.5	0246	2.8	2326	1.9
24	2.2	2346	2.8	1431	1.3
25	2.5	2036	2.8	1406	1.6
26	2.2	2131	3.1	1341	1.6
27	2.8	2356	3.4	0351	2.2
28	3.7	2341	4.0	0401	3.1
29	4.6	1521	4.9	0146	4.0
30	4.6	0131	4.9	2326	4.0
31	5.5	2356	8.7	0231	4.3
TOTAL	117.6		- - -		- - -
AVERAGE	3.8		4.3		3.3
MAXIMUM	6.1		8.7		5.8
MINIMUM	2.2		2.8		1.3
ACRE FT	232.9		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

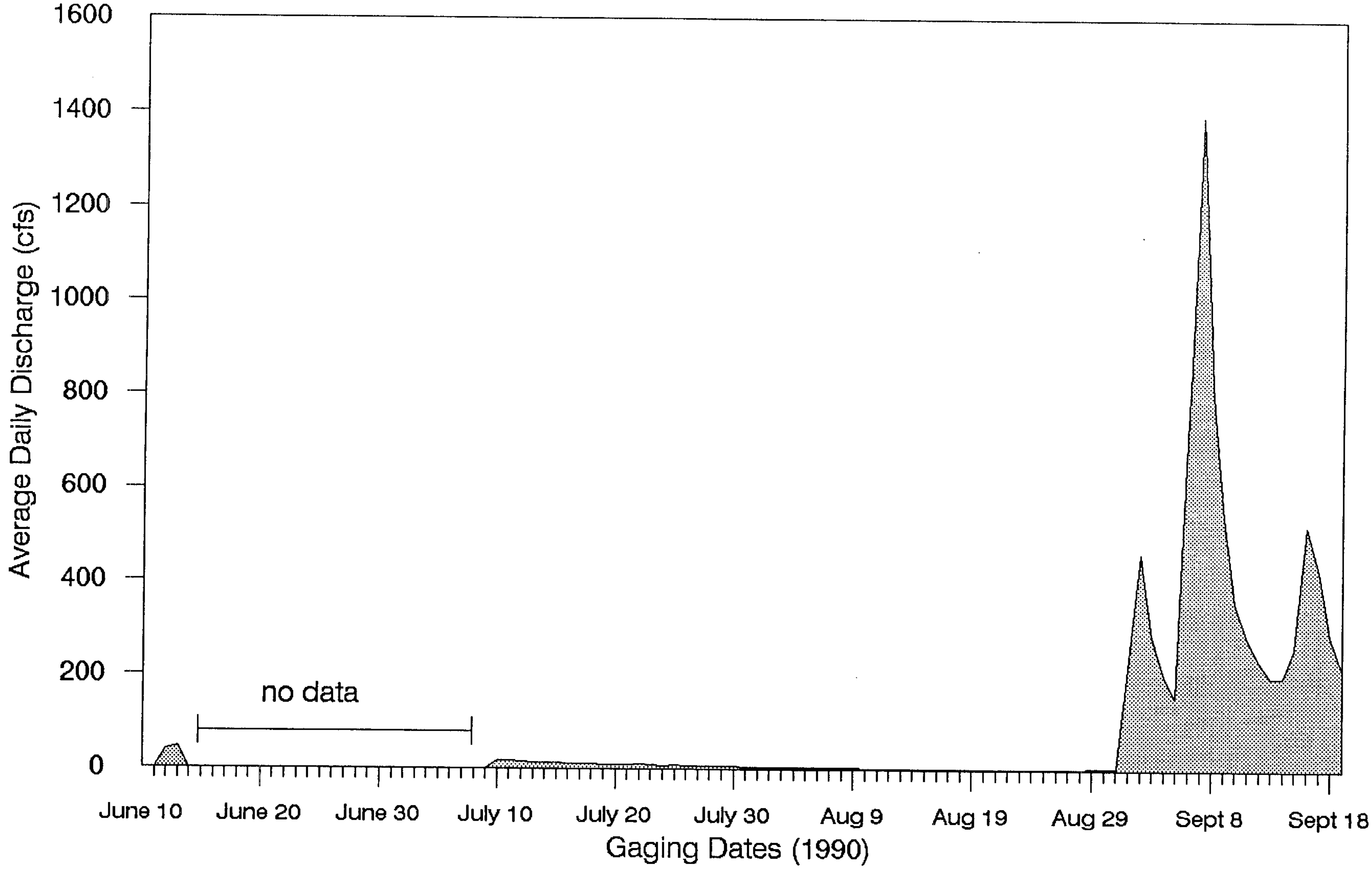
TAMAYARIAK RIVER, LOWER WEST FORK

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	219.1	1226	766.9	0001	8.7
2	460.5	0006	640.2	2341	347.7
3	284.4	0006	362.5	2316	240.8
4	202.2	0001	240.8	2356	168.3
5	154.3	0036	171.2	2336	143.8
6	758.5	2246	2455.1	0006	143.8
7	1396.0	0016	2436.5	2356	1018.3
8	827.4	0001	1081.0	2336	670.4
9	541.9	0006	685.8	1946	460.5
10	357.5	0006	472.4	1616	301.6
11	280.2	0211	367.5	2351	222.6
12	233.4	0656	252.2	2001	215.7
13	198.9	0001	222.6	1301	183.1
14	198.9	2131	212.2	1026	189.3
15	260.0	2351	404.0	0511	198.9
16	522.3	0731	603.7	0006	404.0
17	426.0	0016	589.6	2116	314.9
18	288.6	0151	398.6	2346	202.2
19	212.2	0551	244.5	2326	180.1
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	7822.3		- - -		- - -
AVERAGE	411.7		663.5		295.5
MAXIMUM	1396.0		2455.1		1018.3
MINIMUM	154.3		171.2		8.7
ACRE FT	15488.1		- - -		- - -

Lower West Fork Tamayariak River

1990



ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

LOCATION.-Lat 69°58'33", long 145°46'44", in center sec 12, T.7N., R.25E., 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-61.3 mi^2, of which 0.79 mi^2 are located within the Arctic National Wildlife Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.-Maximum Discharge, 636.9 cfs Sept. 6, 1990 @ 1924 hrs; Minimum Discharge, 0.1 cfs Sept. 19, 1990 @ 2359 hrs.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	26.3	2355	44.2	0005	23.3
13	41.0	2255	47.6	1440	35.9
14	39.9	2350	59.0	1420	34.0
15	44.2	10	59.0	1500	36.9
16	43.1	2350	51.2	1200	39.9
17	53.7	2355	60.3	2400	51.2
18	50.0	0055	61.7	1450	43.1
19	44.2	0055	53.7	1520	37.9
20	37.9	0040	47.6	1720	33.1
21	78.3	1905	155.8	1100	30.4
22	150.6	1505	169.1	0545	138.3
23	- - -	- - -	- - -	- - -	- - -
24	23.3	2324	24.8	1549	21.9
25	22.6	2354	27.1	1639	19.2
26	21.9	0104	27.1	1624	18.0
27	19.8	0104	24.0	1834	16.8
28	16.2	0139	19.2	1829	14.0
29	14.6	0214	16.8	1729	12.6
30	12.1	0504	13.5	1924	9.9
TOTAL	739.8		- - -		- - -
AVERAGE	46.2		51.0		33.0
MAXIMUM	150.6		169.1		138.3
MINIMUM	12.1		13.5		9.9
ACRE FT	1464.8		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	10.7	0424	13.0	2024	8.7
2	9.5	0514	11.6	2044	7.3
3	9.1	0459	11.6	2159	6.7
4	7.3	0719	8.7	2134	5.8
5	6.4	0659	7.3	2124	5.0
6	5.8	0739	7.0	2319	4.5
7	5.2	2344	7.0	0014	4.5
8	7.0	0404	8.4	2359	6.1
9	5.2	0054	6.1	2314	4.7
10	4.5	0524	5.0	2034	4.0
11	4.0	0949	4.5	2324	3.4
12	3.4	0904	3.6	2354	2.8
13	2.8	0734	3.0	2044	2.5
14	2.5	0914	2.8	2219	2.0
15	2.0	0819	2.8	2109	1.6
16	1.9	1014	2.2	0019	1.8
17	2.0	1559	2.2	0314	1.8
18	1.8	0004	2.0	1904	1.5
19	1.5	1259	1.6	1659	1.4
20	1.4	0614	1.6	1809	1.3
21	1.6	2359	2.3	0324	1.3
22	2.5	0644	3.0	2359	2.0
23	1.8	0954	2.0	2229	1.3
24	1.3	0759	1.4	2219	1.2
25	1.2	0654	1.3	2134	1.1
26	1.2	0949	1.4	2154	1.1
27	1.1	0814	1.2	1809	1.0
28	1.0	1049	1.1	1954	0.8
29	0.9	1149	1.1	1909	0.8
30	0.9	0839	1.0	1959	0.7
31	0.8	0854	0.9	2014	0.7
TOTAL	108.3		- - -		- - -
AVERAGE	3.5		4.2		2.9
MAXIMUM	10.7		13.0		8.7
MINIMUM	0.8		0.9		0.7
ACRE FT	214.4		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

AUGUST 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	0.8	0859	0.9	2339	0.8
2	0.7	1019	0.9	1904	0.6
3	0.7	1224	0.7	0004	0.6
4	0.7	0844	0.8	1829	0.7
5	0.7	0549	0.8	2124	0.5
6	0.6	0809	0.7	0059	0.5
7	0.7	1234	0.7	0004	0.6
8	0.7	1019	0.7	0019	0.6
9	0.7	1214	0.7	2229	0.7
10	0.7	1114	0.7	2239	0.7
11	0.7	1014	0.7	2219	0.6
12	0.7	0949	0.7	2259	0.6
13	0.5	1114	0.6	2354	0.4
14	0.5	0729	0.5	1909	0.4
15	0.4	1229	0.5	2034	0.4
16	0.5	1019	0.5	0049	0.4
17	0.5	1214	0.5	1819	0.4
18	0.5	1259	0.5	0104	0.4
19	0.5	0724	0.5	1554	0.4
20	0.5	1044	0.6	0019	0.5
21	0.5	1309	0.6	2254	0.5
22	0.5	1209	0.6	2159	0.5
23	0.5	1124	0.6	1829	0.5
24	0.5	1849	0.6	1534	0.5
25	0.5	1059	0.6	2034	0.4
26	0.5	1259	0.7	1249	0.4
27	0.6	1419	0.7	1954	0.5
28	0.9	1224	1.1	0009	0.7
29	1.3	1724	1.5	0224	1.0
30	1.5	2359	2.2	0409	1.4
31	4.7	1759	33.1	0004	2.2
TOTAL	24.2		- - -		- - -
AVERAGE	0.8		1.8		0.6
MAXIMUM	4.7		33.1		2.2
MINIMUM	0.4		0.5		0.4
ACRE FT	48.0		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

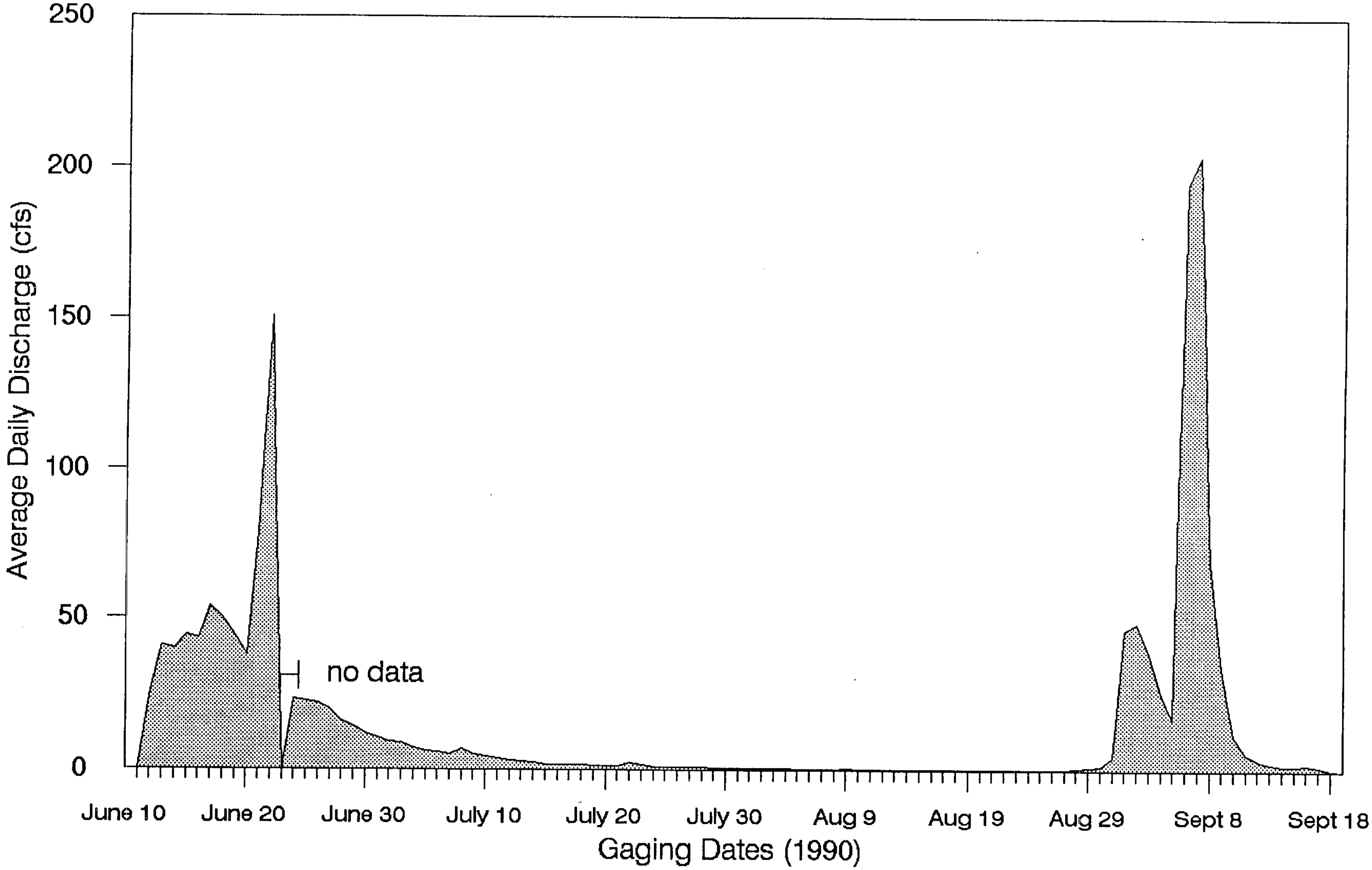
Tamayariak River, Middle Fork

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	46.5	1504	68.9	0004	14.0
2	48.8	0004	59.0	2359	44.2
3	38.9	1504	44.2	2354	32.2
4	25.5	0004	32.2	2359	18.0
5	17.4	2349	20.5	0724	14.0
6	194.9	1924	636.9	0004	20.5
7	204.0	0009	431.8	2359	101.6
8	68.9	0004	101.6	2359	56.3
9	34.0	0009	56.3	2359	20.5
10	11.6	0004	21.2	2359	8.4
11	5.5	0004	8.4	0839	3.6
12	3.6	1334	4.7	2359	2.6
13	2.6	1639	3.8	0814	1.9
14	2.0	1634	3.0	0814	1.4
15	1.9	1744	2.8	0759	1.1
16	2.2	1519	3.6	2329	1.5
17	1.4	1529	1.9	2334	0.9
18	0.7	1644	1.2	2359	0.3
19	0.3	1514	0.5	2359	0.1
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	710.8		- - -		- - -
AVERAGE	37.4		79.1		18.1
MAXIMUM	204.0		636.9		101.6
MINIMUM	0.3		0.5		0.1
ACRE FT	1407.3		- - -		- - -

Middle Fork Tamayariak River

1990



ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, UPPER WEST FORK

LOCATION.--Lat 69°49'58", long 145°55'15", in the center W½W½ sec 33, T.6N., R.25E., 13.9 miles upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--49.2 mi², of which 5.6 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 404 cfs Aug 13, 1988 @ 0315 hrs; Minimum Discharge, 0.0 cfs July 9-10, & 13, 1989, July 16-21, 1990, July 31 to August 19, 1990.

JUNE 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	24.6	2103	49.2	0043	18.1
13	35.2	0003	45.0	1233	30.0
14	30.0	2023	53.6	1208	21.5
15	34.2	2358	95.8	1433	20.1
16	129.8	2123	171.5	0003	98.2
17	129.8	0008	148.0	2358	89.0
18	68.7	0008	86.8	2358	52.1
19	39.9	0003	52.1	2358	31.0
20	27.2	0003	31.0	2358	20.1
21	18.1	0043	20.1	2348	15.2
22	15.2	1703	16.9	2358	13.7
23	11.1	0003	13.7	2358	9.3
24	8.7	1923	9.3	2318	7.6
25	8.7	1913	10.7	0318	7.6
26	7.6	0003	8.7	2353	6.5
27	6.2	0213	6.5	2313	5.1
28	6.0	0918	6.9	0248	5.1
29	7.2	1438	8.7	0023	6.2
30	6.7	1848	7.6	0228	6.2
TOTAL	615.0		- - -		- - -
AVERAGE	32.4		44.3		24.3
MAXIMUM	129.8		171.5		98.2
MINIMUM	6.0		6.5		5.1
ACRE FT	1217.7		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, UPPER WEST FORK

JULY 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	6.2	1248	6.5	2358	5.1
2	5.2	1743	5.8	2358	4.6
3	4.2	0003	4.5	2358	3.7
4	3.7	1818	3.8	2358	3.2
5	3.2	1818	3.5	2358	2.9
6	2.8	0718	3.0	2358	2.3
7	2.1	2358	2.6	2058	1.2
8	2.2	1208	2.7	2318	1.5
9	1.7	1558	2.0	2053	1.2
10	1.8	1058	2.3	2358	1.4
11	1.8	0958	2.1	2358	1.2
12	1.5	1338	1.8	0138	0.9
13	1.2	1013	1.5	0138	0.5
14	1.2	0913	1.7	0108	0.5
15	0.9	0953	1.2	2358	0.1
16	0.3	0948	0.7	2233	0.0
17	0.5	1303	1.1	0003	0.0
18	0.3	0943	0.9	2338	0.0
19	0.0	0948	0.7	2358	0.0
20	0.0	1008	0.5	2138	0.0
21	0.9	2353	2.6	0003	0.0
22	2.6	1113	3.1	2358	2.0
23	2.3	1258	2.6	0118	1.8
24	2.5	1148	2.9	0023	2.0
25	2.2	1123	2.7	2248	1.4
26	2.0	1023	2.5	2358	0.9
27	1.4	1023	2.1	2308	0.5
28	1.4	1328	2.0	0003	0.5
29	1.4	1238	1.7	2353	0.3
30	1.2	1328	1.7	2358	0.1
31	0.9	1208	1.5	2333	0.0
TOTAL	59.1		- - -		- - -
AVERAGE	1.9		2.4		1.1
MAXIMUM	6.2		6.5		5.1
MINIMUM	0.0		0.5		0.0
ACRE FT	117.1		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, UPPER WEST FORK

AUGUST 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	0.7	1458	1.4	2358	0.0
2	0.5	1008	1.1	2323	0.0
3	0.1	1123	0.9	0003	0.0
4	0.3	1228	0.9	2343	0.0
5	0.1	1508	1.1	2353	0.0
6	0.0	1453	0.7	0003	0.0
7	0.0	1533	0.3	2333	0.0
8	0.0	1348	0.1	0003	0.0
9	0.0	1203	0.3	2228	0.0
10	0.0	1508	0.3	2303	0.0
11	0.0	1518	0.5	2318	0.0
12	0.0	1558	0.3	2318	0.0
13	0.0	1623	0.7	2248	0.0
14	0.0	1518	0.1	2243	0.0
15	0.0	1623	0.1	2243	0.0
16	0.0	1718	1.1	0008	0.0
17	0.0	1548	0.9	2233	0.0
18	0.0	1348	0.1	0003	0.0
19	2.0	1543	3.2	0008	0.0
20	2.6	1613	2.9	0003	2.1
21	2.6	1558	3.0	2258	1.8
22	2.3	1623	3.0	2248	1.5
23	2.1	1618	2.9	2233	1.4
24	1.8	1848	2.3	2243	1.2
25	1.7	1608	2.3	2223	0.9
26	1.5	1618	2.3	1933	1.1
27	2.6	1453	2.9	0103	2.2
28	3.5	2358	9.6	0003	2.7
29	49.2	2318	105.5	0003	9.6
30	144.8	2323	261.8	0758	103.0
31	322.8	2353	531.6	0003	257.1
TOTAL	535.5		- - -		- - -
AVERAGE	17.3		30.5		11.6
MAXIMUM	322.8		531.6		257.1
MINIMUM	0.0		0.1		0.0
ACRE FT	1060.3		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

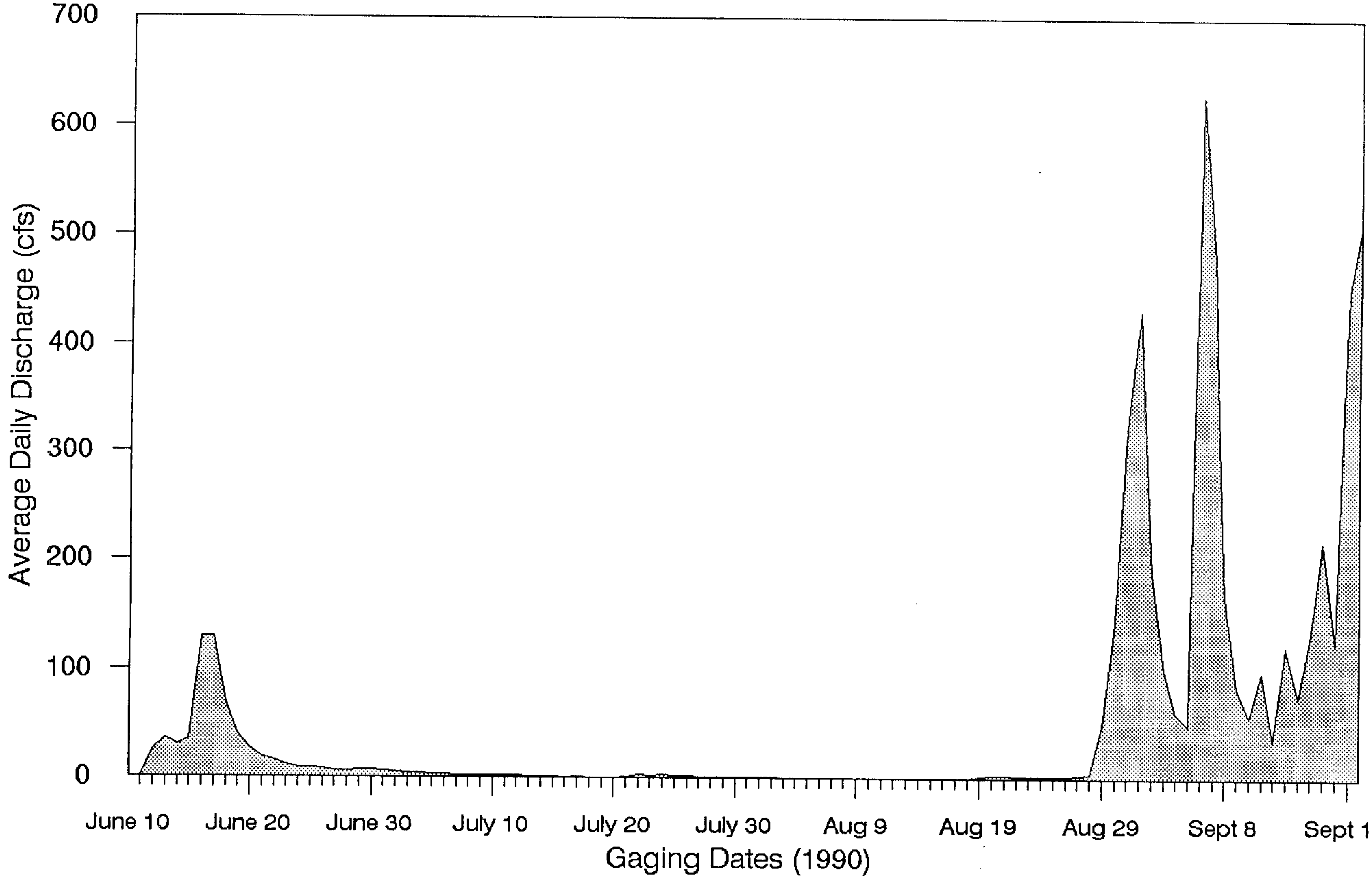
TAMAYARIAK RIVER, UPPER WEST FORK

SEPTEMBER 1990

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	431.5	0553	603.6	2348	281.2
2	189.7	0028	291.2	2358	138.7
3	100.6	0003	138.7	2358	80.4
4	60.0	0003	80.4	2353	47.8
5	49.2	2358	98.2	1218	41.1
6	629.0	1853	1328.4	0003	98.2
7	479.8	0003	1051.9	2353	266.6
8	168.0	0008	271.4	2358	115.8
9	84.6	0003	115.8	2358	50.6
10	56.7	1658	86.8	0508	42.4
11	98.2	1538	837.7	0418	23.0
12	35.2	0013	39.9	1303	30.0
13	121.3	1643	880.1	0858	20.8
14	74.4	0318	637.6	0333	33.1
15	129.8	2353	266.6	0008	60.0
16	217.5	0018	271.4	0928	178.6
17	124.1	0013	193.5	1028	84.6
18	451.8	1803	1064.1	1253	32.0
19	509.0	0008	682.0	0818	16.3
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
TOTAL	4010.3		- - -		- - -
AVERAGE	211.1		470.5		86.4
MAXIMUM	629.0		1328.4		281.2
MINIMUM	35.2		39.9		16.3
ACRE FT	7940.4		- - -		- - -

Upper West Fork Tamayariak River

1990



Appendix B

Surface Water Temperature Records

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

LOCATION.--Lat 60°49'58", long 143°46'50", in center sec. 36, T.6N., R.33E., 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--97.1 mi², of which 66.0 mi² is located within the Arctic National Wildlife Refuge Wildernes Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.--Maximum Temperature, 20.4°C July 4, 1990.

JUNE 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	9.0	1743	12.2	0718	6.5
14	10.3	1728	13.3	0623	7.5
15	11.0	1638	14.0	0643	8.5
16	10.7	1843	12.6	0718	8.8
17	11.4	1838	14.6	0808	9.2
18	12.2	1903	13.7	0523	10.3
19	12.9	1453	15.4	0533	10.4
20	12.8	1618	14.6	0623	10.6
21	11.9	1358	13.1	0633	10.8
22	13.1	1823	16.4	0558	10.0
23	11.9	0003	14.1	2358	9.8
24	11.7	1603	14.7	0618	8.9
25	13.5	1728	16.7	0613	10.8
26	11.8	1748	14.4	0713	9.7
27	12.9	1823	17.5	0633	9.1
28	14.9	1723	18.4	0613	11.8
29	15.4	1508	18.5	0523	12.1
30	16.6	1733	19.7	0633	13.6
AVERAGE	12.6		15.4		10.1
MAXIMUM	16.6		19.7		13.6
MINIMUM	10.3		12.6		7.5

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

JULY 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	17.3	1633	20.4	0548	14.2
2	17.1	1718	19.5	0613	14.7
3	16.9	1713	19.9	0558	14.0
4	17.1	1728	20.4	0558	14.2
5	17.3	1713	20.1	0633	14.4
6	17.0	1718	19.9	0728	14.1
7	13.5	0003	17.1	2358	10.3
8	9.7	0003	10.3	2353	8.8
9	9.0	1453	10.3	0658	8.0
10	8.9	1823	10.2	0543	7.7
11	10.8	1743	14.2	0603	8.0
12	12.7	1813	16.4	0618	9.2
13	13.9	1658	17.1	0558	10.8
14	14.6	1603	17.8	0643	12.1
15	13.6	1943	15.2	0633	12.1
16	12.8	2038	14.4	0713	11.4
17	12.4	0003	13.4	0828	11.9
18	13.1	1823	16.0	0603	11.3
19	13.4	1923	15.3	0753	11.9
20	13.7	1533	15.0	0653	12.5
21	13.2	1753	14.2	2358	12.0
22	11.3	0003	12.0	1018	10.9
23	13.0	1708	16.6	0603	10.1
24	11.8	0003	13.1	2358	10.6
25	9.4	0003	10.6	2353	8.8
26	9.9	1818	12.4	0518	8.3
27	10.1	1853	12.6	0748	8.1
28	9.5	1843	10.3	0738	8.5
29	9.9	1803	11.6	0633	8.8
30	10.6	1828	12.9	0633	8.8
31	10.5	1738	12.8	0708	8.6
AVERAGE	12.7		14.9		10.8
MAXIMUM	17.3		20.4		14.7
MINIMUM	8.9		10.2		7.7

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

AUGUST 1990

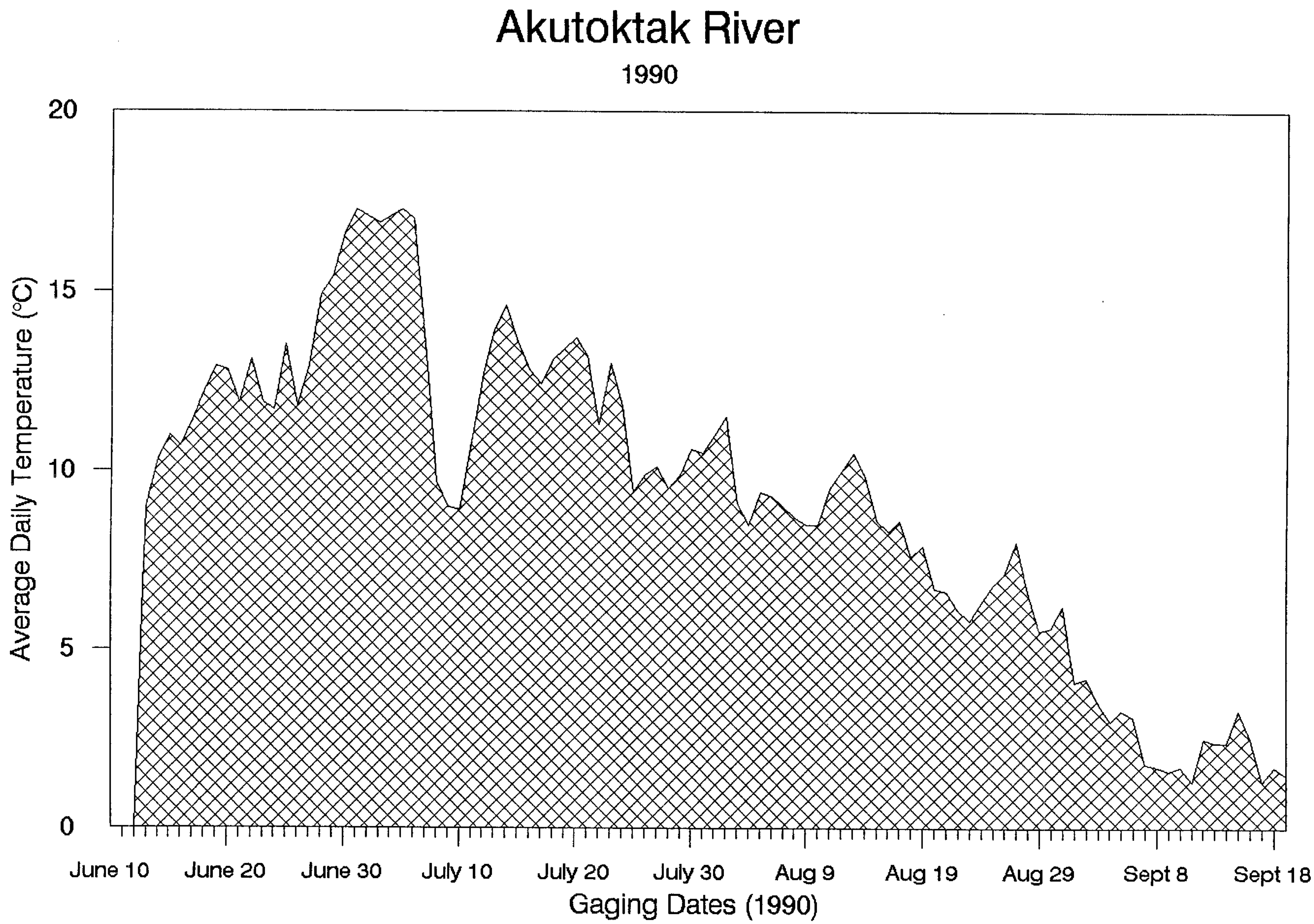
DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	11.0	1643	14.0	0633	8.2
2	11.5	1653	13.9	0728	9.6
3	9.1	0003	10.7	2358	8.3
4	8.5	1553	9.9	0723	7.4
5	9.4	1658	12.7	0713	6.6
6	9.3	1723	10.8	0743	8.1
7	9.0	1908	10.3	0648	7.9
8	8.7	1848	10.1	0638	7.5
9	8.5	1903	9.6	0718	7.3
10	8.5	1848	10.3	0803	7.3
11	9.5	1858	12.5	0803	7.2
12	10.0	1743	13.6	0728	6.8
13	10.5	1648	12.9	0823	8.6
14	9.8	1718	12.5	0843	8.0
15	8.6	1703	10.4	0903	7.5
16	8.3	1723	10.7	0423	6.7
17	8.6	1718	11.8	0753	6.5
18	7.6	1643	8.5	0823	6.8
19	7.9	1703	10.1	0723	6.2
20	6.7	1708	7.6	0803	5.8
21	6.6	1733	8.8	0713	5.0
22	6.1	1803	9.0	0713	3.4
23	5.8	1728	8.3	0753	3.4
24	6.3	1758	8.7	0708	4.2
25	6.8	1608	8.5	2358	5.5
26	7.1	1623	10.1	0633	4.5
27	8.0	1713	9.0	0933	7.2
28	6.6	0003	7.5	2358	5.9
29	5.5	1728	6.0	0843	4.8
30	5.6	1758	6.5	0708	4.6
31	6.2	1628	7.3	0733	5.3
AVERAGE	8.1		10.1		6.5
MAXIMUM	11.5		14.0		9.6
MINIMUM	5.5		6.0		3.4

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

SEPTEMBER 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	4.1	0003	6.0	1208	3.2
2	4.2	1658	6.1	0703	3.0
3	3.5	1748	5.7	0758	1.7
4	3.0	1733	3.9	0833	2.0
5	3.3	1658	4.6	0743	2.2
6	3.1	1608	3.8	2358	2.5
7	1.8	1738	2.7	0743	0.6
8	1.7	1533	2.6	2358	1.0
9	1.6	1718	3.6	0748	0.2
10	1.7	1733	4.1	0423	0.1
11	1.3	1813	2.6	0643	0.1
12	2.5	1718	4.7	0748	0.7
13	2.4	1813	4.1	0823	0.8
14	2.4	1838	3.3	0838	1.4
15	3.3	1613	4.2	0808	2.7
16	2.5	1703	4.4	0848	0.9
17	1.3	0003	2.1	2358	0.8
18	1.7	1703	3.3	0133	0.8
19	1.5	0003	2.1	0808	1.2
20	- - -		- - -		- - -
21	- - -		- - -		- - -
22	- - -		- - -		- - -
23	- - -		- - -		- - -
24	- - -		- - -		- - -
25	- - -		- - -		- - -
26	- - -		- - -		- - -
27	- - -		- - -		- - -
28	- - -		- - -		- - -
29	- - -		- - -		- - -
30	- - -		- - -		- - -
AVERAGE	2.5		27.3		17.5
MAXIMUM	4.2		70.5		44.0
MINIMUM	1.3		9.4		6.9


Akutoktak River
1990
Average Daily Temperature (°C)
0
5
10
15
20
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

LOCATION.--Lat 69°50'19", long 144°24'43", NE¼NW¼NW¼ sec. 33, T.6N., R.31E., 0.6 miles upstream from the confluence with the Itkilyariak Creek, 20.75 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--26.9 mi^2, of which 8.7 mi^2 is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 3rd Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.--Maximum Temperature, 17.7°C Aug. 8, 1989.

JUNE 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	6.9	1814	10.7	0534	3.3
13	7.5	1619	9.7	0709	5.3
14	8.8	1719	11.9	0529	5.8
15	10.2	1534	13.5	0554	7.7
16	10.2	1304	11.9	0629	8.6
17	10.9	1759	13.8	0849	8.5
18	11.5	1429	13.9	0559	9.5
19	11.1	1149	12.9	0544	10.0
20	10.9	1904	13.4	0514	8.1
21	11.0	0004	12.0	0534	10.2
22	12.2	1744	15.6	0509	9.1
23	10.9	0004	12.6	2359	9.1
24	10.7	1414	13.1	0609	8.2
25	12.3	1654	15.0	0459	9.7
26	10.9	1744	13.0	0644	9.3
27	11.5	1759	14.5	0649	8.7
28	13.0	1819	15.3	0544	10.9
29	13.0	1439	15.0	0614	11.2
30	13.5	1729	15.8	0614	11.3
AVERAGE	10.9		13.3		8.7
MINIMUM	13.5		15.8		11.3
MINIMUM	6.9		9.7		3.3

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

JULY 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	14.3	1724	16.6	0604	12.3
2	14.6	1709	16.9	559	12.4
3	15.0	1839	17.4	0534	12.5
4	15.2	1719	17.6	0554	12.9
5	15.2	1729	17.4	0604	12.8
6	15.0	1749	17.3	0629	12.7
7	11.9	0004	15.2	2359	9.1
8	8.2	0004	9.1	2359	7.3
9	7.8	1704	8.9	0509	6.9
10	8.2	1909	9.4	0529	7.1
11	9.6	1829	12.2	0604	7.6
12	11.1	1849	13.8	0654	8.5
13	11.8	1804	13.6	0614	9.6
14	11.4	1634	12.8	0709	9.8
15	11.4	2019	12.6	0624	10.4
16	11.2	1804	12.8	0614	9.5
17	10.7	2134	11.4	0749	10.1
18	12.0	1614	14.4	0539	9.7
19	12.0	1909	13.9	0634	10.2
20	12.2	1624	13.7	0604	10.7
21	12.0	1614	13.4	2359	11.0
22	10.5	0004	10.9	1034	9.8
23	11.6	1539	14.0	0544	9.3
24	10.4	1704	11.7	2359	9.4
25	8.8	0004	9.4	2359	8.2
26	8.7	1714	10.5	0554	7.5
27	8.3	1754	10.7	0539	6.4
28	7.9	1649	8.8	0639	7.0
29	8.7	1719	10.4	0619	7.6
30	9.5	1704	11.7	0609	7.8
31	9.2	1604	11.0	0624	7.6
AVERAGE	11.1		12.9		9.5
MAXIMUM	15.2		17.6		12.9
MINIMUM	7.8		8.8		6.4

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

AUGUST 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	9.5	1649	12.0	0559	7.3
2	9.7	1649	11.8	0644	8.3
3	7.7	0004	8.6	2354	7.0
4	7.2	1649	8.2	0719	6.3
5	8.3	1719	11.1	0634	5.9
6	8.2	1644	9.1	0724	7.4
7	7.9	1844	8.8	0634	7.1
8	7.7	1804	8.7	0619	6.7
9	7.4	1909	8.4	0654	6.5
10	7.4	1829	8.6	0629	6.5
11	8.1	1719	10.5	0719	6.4
13	8.7	1734	11.1	0749	6.9
14	8.5	1744	10.7	0759	7.1
18	6.9	1704	7.7	0709	6.2
19	6.9	1654	9.0	0739	5.7
20	5.8	1744	6.8	0744	5.2
21	5.7	1744	7.7	0709	4.4
22	5.3	1709	7.9	0734	3.1
23	5.2	1709	7.6	0729	3.2
24	5.4	1659	7.5	0729	3.5
25	5.9	1654	7.8	0814	4.7
27	6.8	1509	7.5	2339	5.9
28	5.9	1634	6.9	0719	5.2
29	5.0	1649	5.5	0754	4.5
30	5.2	1704	6.1	0554	4.3
31	5.7	1554	6.7	0654	4.8
AVERAGE	7.1		8.8		5.8
MAXIMUM	9.7		12.0		8.3
MINIMUM	5.0		5.5		3.1

ARCTIC NATIONAL WILDLIFE REFUGE

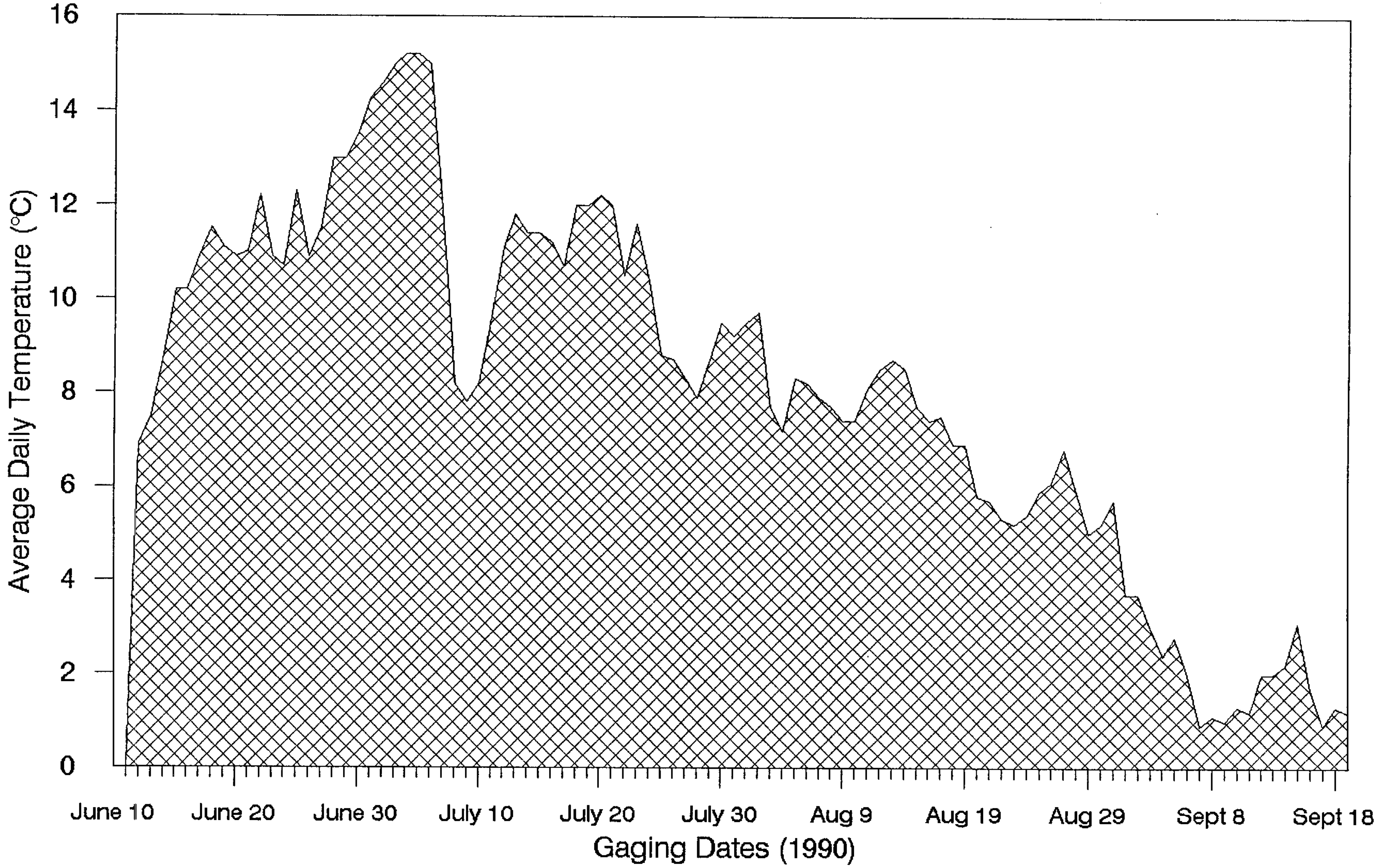
Itkilyariak Creek, West Fork

SEPTEMBER 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	3.7	0004	5.4	1109	2.7
2	3.7	1604	5.4	0639	2.7
3	3.0	1644	5.3	0734	1.2
4	2.4	1434	3.5	0739	1.2
5	2.8	1704	4.1	0729	1.8
6	2.0	1514	2.6	2359	0.8
7	0.9	1714	2.3	0709	-0.1
8	1.1	1514	2.1	0644	0.4
9	1.0	1644	3.0	0709	-0.1
10	1.3	1624	3.5	0114	-0.1
11	1.2	1649	2.7	0504	0.0
12	2.0	1634	4.0	0554	0.5
13	2.0	1649	3.8	0744	0.5
14	2.2	1724	3.1	0759	1.2
15	3.1	1409	4.3	2359	2.1
16	1.7	1649	3.6	0749	0.0
17	0.9	1514	1.5	0824	0.4
18	1.3	1639	2.7	0034	0.4
19	1.2	1544	1.6	0724	0.8
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	2.0		3.4		0.9
MAXIMUM	3.7		5.4		2.7
MINIMUM	0.9		1.5		-0.1

West Fork Itkilyariak Creek

1990



ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

LOCATION.--Lat 69°38′, long 144° 22′50", in NW¼SW¼ sec. 31, T.4N., R.32E., 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.--520.1 mi², of which 517.5 mi² is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi² depending on existing climatic conditions.

PERIOD OF RECORD.-- July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.--Maximum Temperature, 15.9°C August 13, 1989 and July 6, 1990.

JUNE 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	6.1	1807	9.2	0717	2.7
12	8.9	1832	13.1	0557	4.9
13	10.4	1747	11.7	0847	9.4
14	10.6	1852	13.4	0742	8.0
15	10.6	1537	12.4	0752	8.8
16	8.4	1827	10.2	0642	6.7
17	8.9	1912	11.5	0832	6.4
18	8.7	0002	10.7	0657	6.4
19	8.7	1347	10.3	0707	7.3
20	8.5	2057	11.3	0632	6.0
21	9.1	0002	10.6	2357	8.2
22	10.1	1932	13.7	0627	7.1
23	9.8	0002	12.2	2357	7.8
24	9.1	2027	11.9	0602	6.3
25	11.4	1857	14.6	0637	8.3
26	12.1	1657	14.0	0742	9.9
27	12.6	1812	14.8	0657	10.0
28	12.3	1657	14.1	0657	10.1
29	10.8	1907	12.5	0752	9.0
30	11.0	1907	14.1	0642	8.0
AVERAGE	9.9		12.3		7.6
MAXIMUM	12.6		14.8		10.1
MINIMUM	6.1		9.2		2.7

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

JULY 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	12.3	1827	15.1	0642	9.5
2	12.7	1917	15.1	0727	10.0
3	12.8	1752	15.7	0707	10.2
4	12.5	1802	15.2	0722	9.7
5	12.6	1747	15.6	0637	9.5
6	13.0	1722	15.9	0732	10.5
7	10.8	0002	12.7	2357	8.5
8	6.0	0002	8.4	2357	5.3
9	5.9	2137	7.1	0637	5.0
10	7.8	2012	9.8	0647	6.2
11	9.5	1947	13.0	0732	6.6
12	11.6	1837	14.6	0722	8.7
13	11.0	1757	12.6	0622	8.7
14	11.0	1647	12.6	0752	9.3
15	10.4	1847	12.1	0802	9.1
16	9.9	2047	11.1	0712	8.3
17	9.4	0002	10.8	0917	8.7
18	11.5	1922	14.3	0712	9.0
19	11.8	1827	13.8	0842	9.5
20	11.9	1747	13.5	0722	10.4
21	11.6	1837	13.8	0702	10.2
22	10.8	1802	12.3	1002	9.6
23	11.5	1822	13.9	0632	9.6
24	10.4	0002	11.9	0842	9.1
25	7.7	0002	9.9	1137	7.1
26	7.9	1847	10.7	0632	6.4
27	8.8	1822	11.4	0747	6.4
28	8.0	0002	9.7	0647	7.1
29	9.2	2012	11.2	0742	7.5
30	10.1	2012	11.8	0737	8.7
31	10.3	1752	11.8	0857	8.9
AVERAGE	10.3		12.5		8.5
MAXIMUM	13.0		15.9		10.5
MINIMUM	5.9		7.1		5.0

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

AUGUST 1990

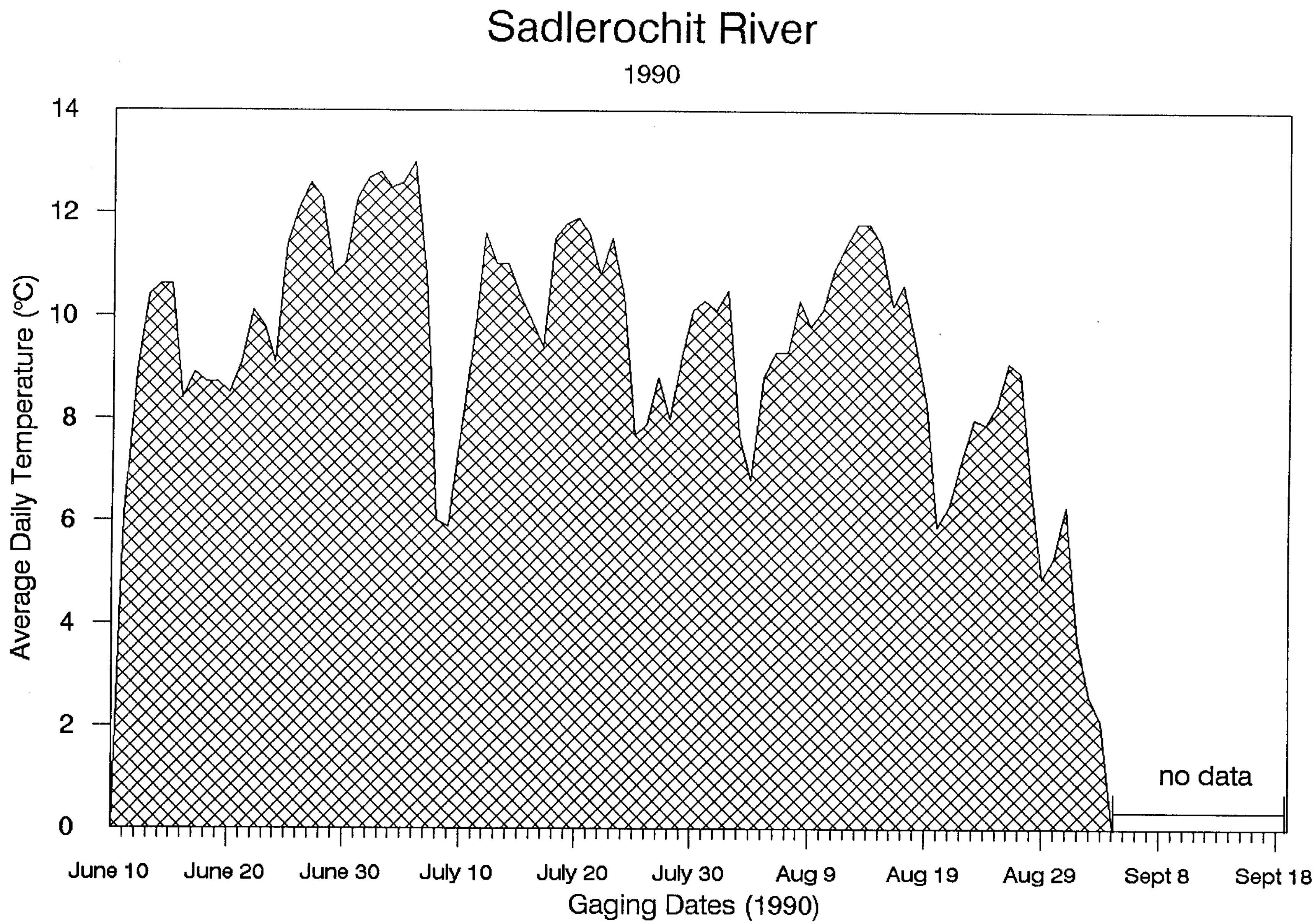
DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	10.1	1832	12.9	0737	7.4
2	10.5	1912	12.5	0657	8.7
3	7.7	0002	10.5	2357	6.9
4	6.8	1912	7.8	0822	6.0
5	8.8	1902	12.0	0712	5.8
6	9.3	0002	10.7	0742	8.0
7	9.3	2117	10.1	0752	8.4
8	10.3	1747	12.4	0932	8.4
9	9.8	0002	11.4	1017	8.6
10	10.1	1727	11.9	0827	8.7
11	10.9	1902	13.2	0832	9.1
12	11.4	1832	14.1	0752	8.7
13	11.8	1807	14.0	0737	9.6
14	11.8	1837	14.1	0757	9.8
15	11.4	1802	12.7	1107	10.2
16	10.2	2047	11.3	0952	9.1
17	10.6	1802	12.9	0732	8.4
18	9.5	0002	11.1	0827	8.4
19	8.3	0002	9.8	2357	7.1
20	5.9	0002	7.1	0752	4.9
21	6.3	1812	8.8	0752	4.2
22	7.2	1852	9.9	0752	4.4
23	8.0	1757	10.3	0842	5.7
24	7.9	1747	10.2	0802	5.6
25	8.3	1707	9.9	0752	6.8
26	9.1	1717	11.3	0352	6.9
27	8.9	0002	10.4	0857	8.1
28	6.7	0002	8.2	2357	5.9
29	4.9	0002	5.9	1017	4.5
30	5.3	1832	6.7	0722	4.1
31	6.3	1637	7.0	0902	5.6
AVERAGE	8.8		10.7		7.2
MAXIMUM	11.8		14.1		10.2
MINIMUM	4.9		5.9		4.1

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

SEPTEMBER 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	3.7	0002	5.9	2357	2.7
2	2.6	1617	3.5	0827	1.8
3	2.1	1807	4.1	0712	0.1
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	- - -		- - -		- - -
MAXIMUM	- - -		- - -		- - -
MINIMUM	- - -		- - -		- - -


Sadlerochit River
1990
Average Daily Temperature (°C)
0
2
4
6
8
10
12
14
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)
no data

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

LOCATION.--Lat 69°39'53", long 144°24'52", NE¼NW¼ sec. 36, T.4N., R.31E., 3000 ft. downstream of Sadlerochit Spring, 37.5 mi. southwest of Kaktovik, Alaska.

DRAINAGE AREA.--0.5 mi².

PERIOD OF RECORD.--July to Dec. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 2nd Order drainage with 2 springs contributing most of the flow.

EXTREME FOR PERIOD OF RECORD.--Maximum Temperature, 16.6°C July 23, 1990.

JUNE 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	12.2	1452	14.1	0507	10.4
12	13.2	1532	14.9	0042	11.3
13	13.0	1337	14.7	0247	12.2
14	13.5	1507	15.1	0412	12.1
15	13.5	1407	15.4	0222	12.5
16	13.3	1822	14.5	0507	12.4
17	12.9	1747	14.0	0817	12.2
18	12.5	1002	13.7	1712	11.4
19	12.7	1202	14.8	0302	11.6
20	13.1	1327	15.0	0357	11.4
21	12.8	1037	13.8	2347	12.1
22	13.3	1517	15.1	0322	11.6
23	12.2	1042	13.7	1937	11.4
24	12.8	1437	14.6	0212	11.4
25	13.5	1427	15.1	0122	11.8
26	13.2	1517	14.8	0057	12.0
27	13.6	1322	15.3	0317	11.9
28	13.9	1342	15.4	0257	12.6
29	13.5	1307	15.7	0137	12.6
30	14.0	1332	15.6	0412	12.5
AVERAGE	13.1		14.8		11.9
MAXIMUM	14.0		15.7		12.6
MINIMUM	12.2		13.7		10.4

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

JULY 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	14.2	1457	15.9	0307	12.6
2	14.1	1422	15.6	0312	12.6
3	14.3	1432	15.8	0232	12.8
4	14.1	1437	15.6	0337	12.8
5	14.1	1452	15.8	0257	12.6
6	14.0	1512	15.8	0327	12.8
7	12.9	1202	14.7	2337	11.6
8	12.1	1432	12.4	0057	11.7
9	12.3	1402	12.8	0352	11.9
10	13.0	1417	13.6	0342	12.3
11	14.3	1452	15.8	0332	13.1
12	14.4	1437	16.0	0312	13.1
13	14.2	1247	16.0	0312	13.0
14	14.3	1207	16.0	0157	13.2
15	14.1	1542	15.2	0422	13.4
16	14.2	1522	15.3	0202	13.4
17	14.0	1937	14.6	0002	13.7
18	14.6	1342	15.9	0437	13.6
19	14.5	1402	16.0	0332	13.4
20	14.3	1442	16.1	0102	13.6
21	14.2	1717	15.5	2357	13.6
22	13.9	1722	14.3	0307	13.5
23	14.8	1327	16.6	0452	13.5
24	14.3	1302	14.9	2307	13.9
25	13.7	1442	14.0	0617	13.5
26	13.9	1147	14.4	2342	13.3
27	14.1	1317	15.5	0147	13.1
28	13.7	1527	14.1	0512	12.9
29	14.2	1232	14.8	0427	13.7
31	14.4	1542	15.5	2357	13.5
AVERAGE	14.0		15.1		13.1
MAXIMUM	14.8		16.6		13.9
MINIMUM	12.1		12.4		11.6

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

AUGUST 1990

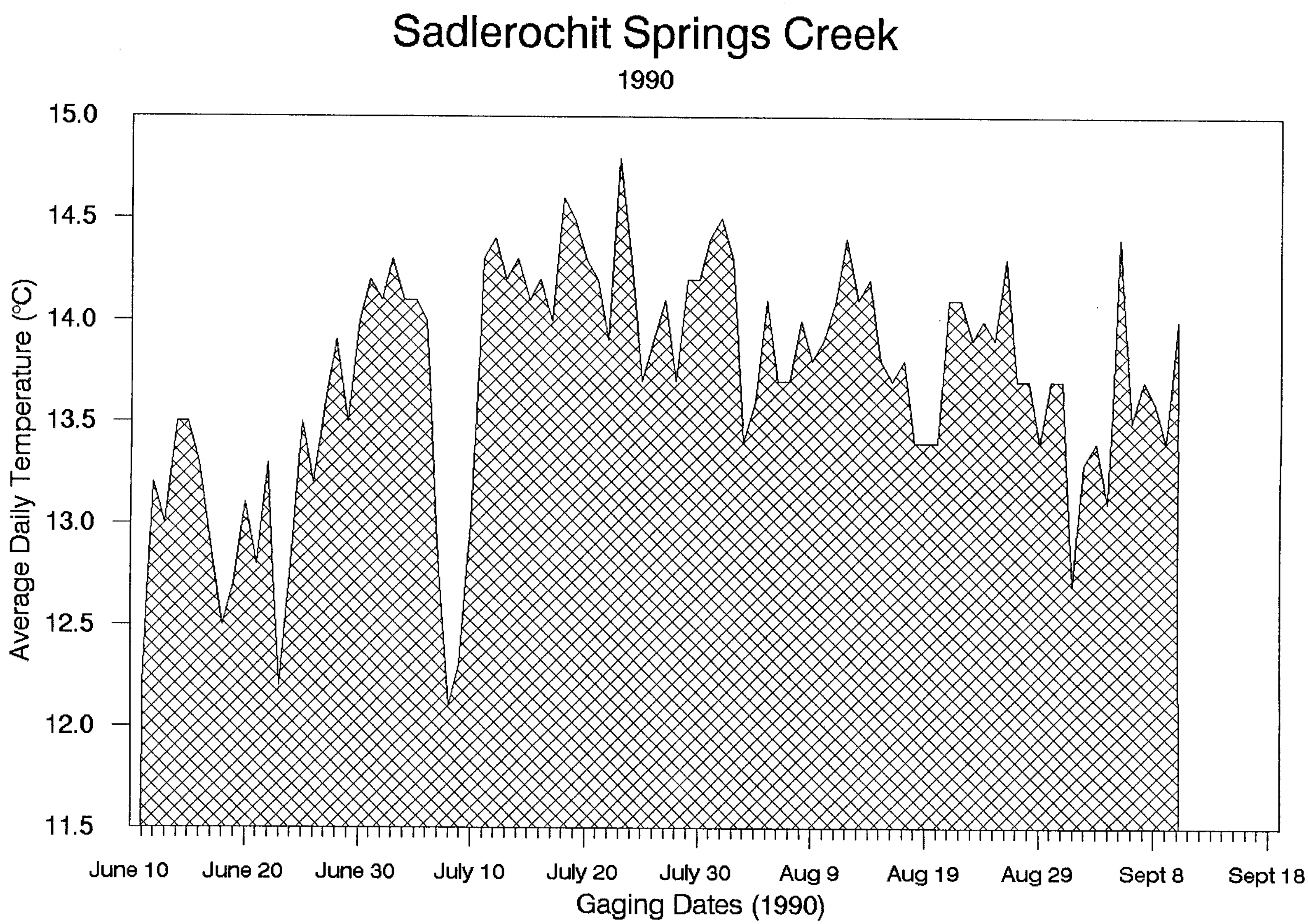
DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	14.5	1427	15.9	0112	13.2
2	14.3	1327	15.7	0422	13.5
3	13.4	1252	13.8	0822	13.1
4	13.6	1447	14.0	2357	13.1
5	14.1	1502	15.6	0337	12.7
6	13.7	1512	14.3	0337	13.0
7	13.7	1457	14.2	0412	13.2
8	14.0	1607	15.0	0222	13.1
9	13.8	1352	14.3	2357	13.4
10	13.9	1637	14.9	0027	13.3
11	14.1	1437	15.4	2357	13.3
12	14.4	1417	16.0	0437	13.1
13	14.1	1512	15.5	2337	13.1
14	14.2	1527	15.4	0002	13.2
15	13.8	1642	14.9	2327	12.9
16	13.7	1622	14.3	0042	12.9
17	13.8	1517	15.1	2342	12.8
18	13.4	1252	14.1	0017	12.8
19	13.4	1547	14.3	2357	12.8
20	13.4	1702	14.1	0442	12.4
21	14.1	1542	15.4	0522	13.3
22	14.1	1457	15.5	0552	12.8
23	13.9	1352	15.2	2332	12.7
24	14.0	1442	15.3	0002	12.9
25	13.9	1452	15.0	2232	12.9
26	14.3	1447	15.6	0012	13.2
27	13.7	1507	14.7	0802	13.1
28	13.7	1322	14.2	2322	13.4
29	13.4	2137	13.7	0817	13.1
30	13.7	1227	14.5	0112	13.1
31	13.7	1127	14.5	1917	13.1
AVERAGE	13.9		14.9		13.0
MAXIMUM	14.5		16.0		13.5
MINIMUM	13.4		13.7		12.4

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit Spring Creek

SEPTEMBER 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	12.7	0112	13.3	0557	11.9
2	13.3	1322	13.9	2357	12.8
3	13.4	1557	14.5	0707	12.7
4	13.1	1442	14.0	0642	11.9
5	14.4	1257	14.9	2217	13.5
6	13.5	0827	14.0	2002	12.9
7	13.7	1327	14.5	0542	12.6
8	13.6	1052	14.4	1907	12.3
9	13.4	1442	14.4	0342	12.6
10	14.0	2352	15.0	0252	13.0
11	- - -	- - -	- - -	- - -	- - -
12	- - -	- - -	- - -	- - -	- - -
13	- - -	- - -	- - -	- - -	- - -
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	13.5		14.3		12.6
MAXIMUM	14.4		15.0		13.5
MINIMUM	12.7		13.3		11.9


Sadlerochit Springs Creek
1990
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
Average Daily Temperature (°C)
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

LOCATION.--Lat 69°54'43", Long 142°30'52", SE¼SE¼ sec. 36, T.7N., R.38E., at confluence with the West Fork Sikrelurak River, 31 mi south-east of Katktovik, Alaska.

DRAINAGE AREA.-74.7 mi².

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.--Maximum Temperature, 19.6°C July 1, 1990.

JUNE 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	3.8	1812	8.1	0557	-0.1
12	5.1	1652	9.2	0537	1.2
13	5.6	1702	9.8	0522	2.5
14	6.9	1702	10.5	0532	3.9
15	5.9	1632	8.9	0627	3.8
16	5.8	2002	7.7	0502	3.8
17	6.5	1757	10.2	0647	4.0
18	8.2	1647	12.3	0602	4.8
19	8.2	1527	11.4	0552	5.2
20	9.7	1737	14.1	0512	5.4
21	9.3	1402	12.9	0712	6.5
22	9.6	1637	13.7	0527	6.0
23	9.2	1432	12.1	0542	7.0
24	8.9	1457	12.8	0442	5.8
25	9.8	1657	13.9	0442	6.3
26	7.8	1732	9.8	0727	6.1
27	9.3	1702	14.1	0522	5.3
28	11.2	1547	15.3	0517	7.3
29	12.4	1807	17.2	0447	7.6
30	15.0	1737	19.1	0542	10.8
AVERAGE	8.4		12.2		5.2
MAXIMUM	15.0		19.1		10.8
MINIMUM	3.8		8.1		-0.1

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

JULY 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	15.6	1632	19.6	0532	11.4
2	14.8	1602	18.2	0547	11.9
3	13.4	1617	16.3	0522	10.4
4	13.9	1717	18.0	0542	10.4
5	14.7	1647	18.2	0537	11.5
6	14.8	1727	18.2	0612	11.8
7	11.0	0002	14.4	2357	7.7
8	7.5	1822	8.5	0717	6.5
9	8.1	1557	11.0	0512	6.1
10	7.9	1712	9.5	0527	6.5
11	8.8	1707	12.2	0632	6.8
12	9.8	1557	12.6	0607	7.2
13	12.1	1657	16.5	0557	8.6
14	12.4	1552	16.5	0617	10.0
15	12.0	1452	14.5	0602	9.8
16	11.4	1557	14.4	0657	8.9
17	11.6	1632	12.7	0352	10.4
18	12.3	1632	14.4	0627	10.3
19	11.4	0002	12.9	2357	10.8
20	12.0	1717	14.5	0502	9.8
21	12.5	1557	14.4	0247	10.3
22	10.7	0002	11.6	0752	10.0
23	13.0	1637	17.3	0532	9.3
24	11.1	1652	12.5	2357	9.7
25	9.4	1802	11.2	0737	8.0
26	10.5	1722	13.8	0527	8.0
27	10.5	1727	13.5	0717	8.0
28	10.3	1707	12.8	0647	8.4
29	10.1	1622	12.0	0612	8.6
30	10.9	1712	14.0	0717	8.7
31	10.4	1757	13.2	0657	8.7
AVERAGE	11.4		14.2		9.2
MAXIMUM	15.6		19.6		11.9
MINIMUM	7.5		8.5		6.1

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

AUGUST 1990

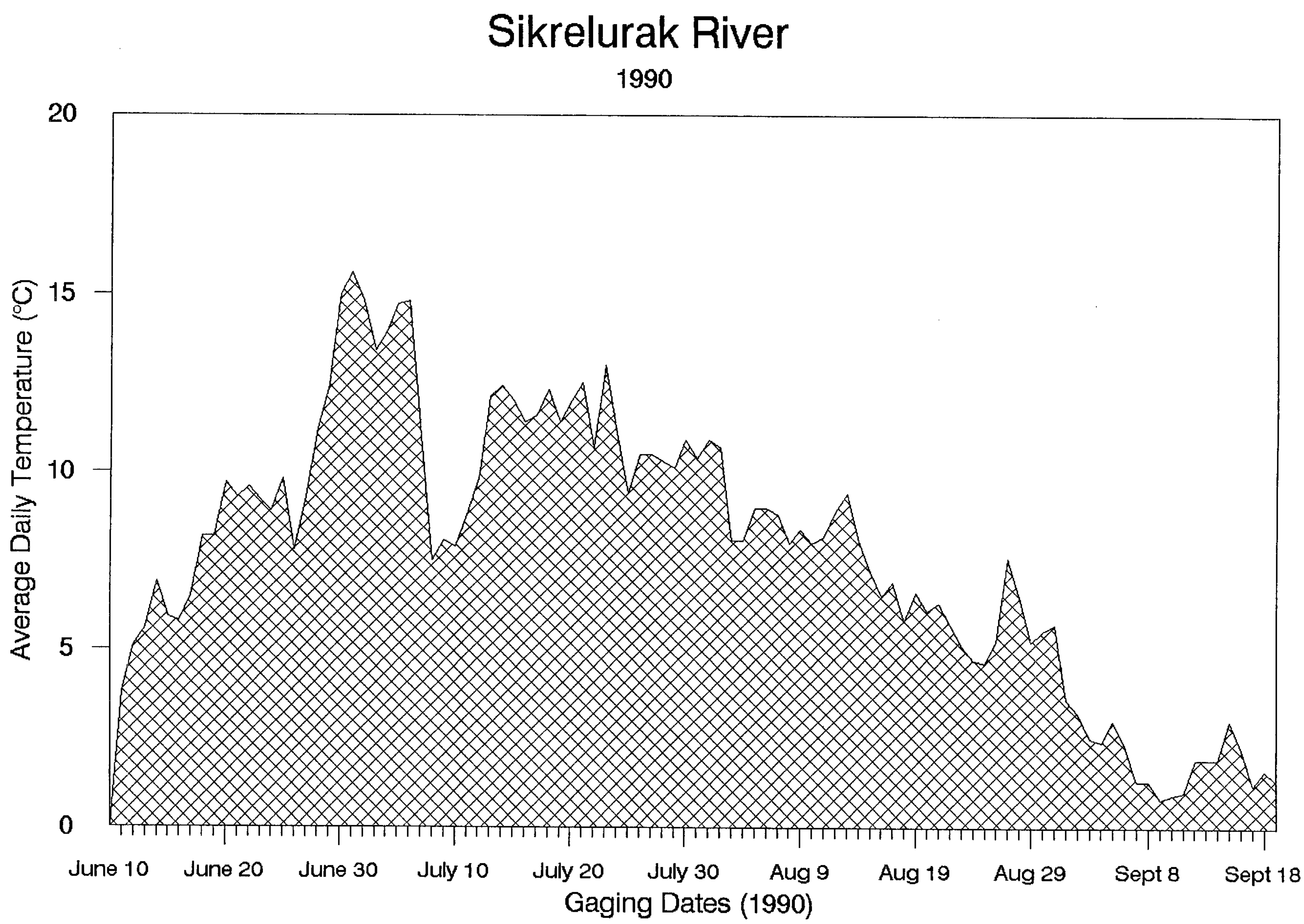
DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	10.9	1652	14.6	0532	8.0
2	10.7	1542	13.1	0712	8.8
3	8.1	0002	9.8	2357	7.2
4	8.1	1602	10.5	0557	6.4
5	9.0	1642	12.4	0612	5.9
6	9.0	1612	12.1	0552	6.7
7	8.8	1657	11.6	0622	7.1
8	8.0	1857	9.6	0727	6.6
9	8.4	1727	10.4	0812	6.7
10	8.0	1852	9.4	0822	7.1
11	8.2	1802	11.0	0707	6.6
12	8.9	1822	11.7	0642	6.7
13	9.4	1602	11.8	0652	7.6
14	8.1	1732	10.4	0542	6.3
15	7.2	1552	9.8	2357	5.6
16	6.5	1447	8.8	0552	4.4
17	6.9	1712	10.0	0537	4.5
18	5.8	1717	6.7	0722	5.1
19	6.6	1712	9.5	0602	4.4
20	6.1	1752	7.5	0957	5.2
21	6.3	1717	8.9	0907	4.4
22	5.7	1807	8.3	1002	3.3
23	5.1	1632	6.3	2357	4.2
24	4.7	1722	6.7	0637	3.0
25	4.6	1522	5.5	2357	3.0
26	5.2	1732	8.8	0532	2.7
27	7.6	1727	8.6	0932	6.8
28	6.5	1642	7.3	0912	5.7
29	5.2	0002	6.0	0822	4.6
30	5.5	1827	7.0	0747	4.2
31	5.7	1522	6.6	0802	4.9
AVERAGE	7.3		9.4		5.6
MAXIMUM	10.9		14.6		8.8
MINIMUM	4.6		5.5		2.7

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

SEPTEMBER 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	3.6	0002	5.2	2357	2.5
2	3.2	1632	5.2	0702	1.7
3	2.5	1627	5.0	0637	0.5
4	2.4	1517	3.4	0722	1.5
5	3.0	1452	4.5	0717	2.0
6	2.3	1552	2.8	2357	1.8
7	1.3	1732	2.4	0827	0.1
8	1.3	1537	2.5	2357	0.3
9	0.8	1742	2.3	0642	-0.1
10	0.9	1732	2.9	0122	-0.1
11	1.0	1742	2.6	0242	-0.1
12	1.9	1707	4.5	0737	0.0
13	1.9	1702	4.3	0637	0.0
14	1.9	1817	2.8	0802	0.7
15	3.0	1637	4.1	0712	2.3
16	2.2	1642	4.3	0727	0.3
17	1.2	1617	1.9	2352	0.6
18	1.6	1707	3.1	0002	0.6
19	1.3	1527	1.9	0202	0.9
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	2.0		3.5		0.8
MAXIMUM	3.6		5.2		2.5
MINIMUM	0.8		1.9		-0.1


Sikrelurak River
1990
Average Daily Temperature (°C)
20
15
10
5
0
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, LOWER WEST FORK

LOCATION.--Lat 69°58'50", long 145°47'40", NW¼NW¼sec 12, T.7N., R.25E., 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--98.14 mi², of which 5.55 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.--Maximum Temperature, 16.6°C July 15, 1989.

JUNE 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	5.6	1738	9.3	0503	2.1
13	6.4	1558	8.5	0718	4.7
14	- - -	- - -	- - -	- - -	- - -
15	- - -	- - -	- - -	- - -	- - -
16	- - -	- - -	- - -	- - -	- - -
17	- - -	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -
19	- - -	- - -	- - -	- - -	- - -
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	- - -		- - -		- - -
MAXIMUM	- - -		- - -		- - -
MINIMUM	- - -		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, LOWER WEST FORK

JULY 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	6.1	1611	7.6	0511	4.9
11	7.6	1711	10.8	0526	5.0
12	9.6	1731	13.2	0521	6.1
13	9.6	1836	12.0	0356	8.0
14	10.8	1501	13.4	0411	8.4
15	11.7	1606	14.4	0611	9.3
16	11.1	1446	12.8	0621	9.4
17	10.4	1921	11.2	2356	9.9
18	11.2	1621	13.4	0551	9.2
19	11.3	1721	13.6	0501	9.3
20	11.7	1711	13.5	0501	10.0
21	11.5	1516	12.7	2356	10.4
22	10.7	1621	13.0	1011	9.4
23	11.8	1651	14.7	0531	9.0
24	10.2	1416	12.5	2356	8.4
25	7.9	1601	8.7	0551	7.2
26	8.7	1616	11.3	0526	6.7
27	8.3	1446	10.8	0531	6.3
28	7.5	1536	8.8	0711	6.5
29	8.2	1821	10.8	0531	6.7
30	8.6	1731	10.9	0611	7.1
31	8.2	1716	11.0	0441	6.5
AVERAGE	9.7		11.9		7.9
MAXIMUM	11.8		14.7		10.4
MINIMUM	6.1		7.6		4.9

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, LOWER WEST FORK

AUGUST 1990

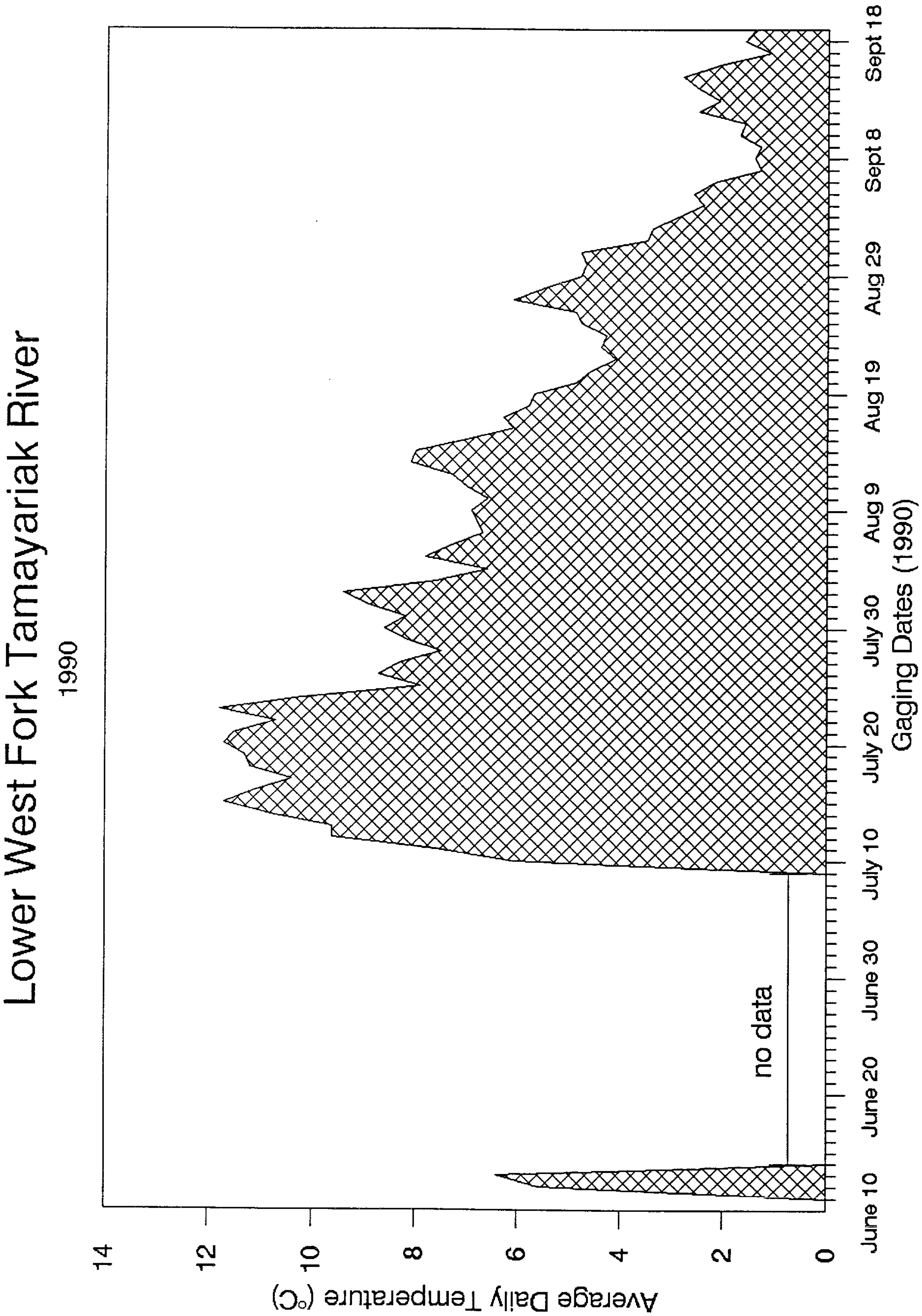
DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	8.9	1656	12.0	0526	6.1
2	9.4	1536	12.1	0616	7.2
3	7.6	0001	8.6	2356	6.6
4	6.6	1446	8.1	0416	5.2
5	7.8	1631	10.3	0651	5.7
6	7.3	1656	8.7	0601	6.2
7	6.7	1756	7.9	0556	5.8
8	6.8	1756	8.0	0636	5.8
9	6.9	1611	8.4	0641	5.7
10	6.6	1631	8.2	0621	5.6
11	7.0	1511	9.2	0646	5.4
12	7.3	1546	10.1	0601	5.0
13	8.1	1556	10.4	0616	6.6
14	8.0	1626	10.2	0606	6.6
15	7.0	1701	8.7	2356	5.8
16	6.1	1726	6.8	2356	5.2
17	6.3	1641	8.7	0546	4.9
18	5.8	1706	6.7	2356	5.2
19	5.7	1626	7.5	0701	4.6
20	4.9	1631	6.3	0626	4.2
21	4.6	1441	6.1	0746	3.4
22	4.1	1641	6.6	0711	2.2
23	4.4	1726	6.3	0806	2.7
24	4.3	1621	6.3	0746	2.6
25	4.8	1621	7.0	0736	3.6
26	4.9	1631	7.8	0451	3.3
27	6.1	1721	7.0	0846	5.4
28	5.5	1516	6.5	0651	4.7
29	4.8	1716	5.4	0741	4.3
30	4.7	1536	5.7	0556	4.0
31	4.8	1441	5.5	0716	4.1
AVERAGE	6.3		8.0		5.0
MAXIMUM	9.4		12.1		7.2
MINIMUM	4.1		5.4		2.2

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, LOWER WEST FORK

SEPTEMBER 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	3.5	0031	4.9	0911	2.4
2	3.4	1541	4.4	0841	2.7
3	2.9	1531	4.8	0721	1.3
4	2.4	1541	3.6	0741	1.2
5	2.6	1526	3.5	0706	1.9
6	2.2	1401	3.0	2356	1.6
7	1.3	1756	2.1	0751	0.4
8	1.4	1436	2.2	2356	1.0
9	1.3	1656	3.0	0746	0.3
10	1.7	1646	3.7	0601	0.4
11	1.6	1556	3.4	0506	0.2
12	2.5	1621	4.6	0741	1.2
13	2.1	1716	4.6	0751	0.2
14	2.5	1651	3.8	0736	1.4
15	2.8	1746	3.6	0831	1.8
16	2.1	1631	3.9	0751	0.8
17	1.1	1626	2.0	0736	0.4
18	1.6	1646	3.5	0131	0.4
19	1.4	1556	1.9	2356	0.9
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	2.1		3.5		1.2
MAXIMUM	3.5		4.9		2.7
MINIMUM	1.1		1.9		0.2



Lower West Fork Tamayariak River
1990
Average Daily Temperature (°C)
0
2
4
6
8
10
12
14
no data
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

LOCATION.-Lat 69°58'33", long 145°46'44", in center sec 12, T.7N., R.25E., 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.-61.3 mi^2, of which 0.79 mi^2 are located within the Arctic National Wildlife Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.-This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.-Maximum Temperature, 19.9°C July 3, 1990.

JUNE 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	6.7	1735	10.7	0605	2.7
13	7.2	1700	9.3	0740	5.2
14	7.6	1700	11.0	0605	4.4
15	7.4	1410	9.9	0620	5.6
16	7.0	2100	9.1	0640	4.9
17	8.6	1800	12.0	0700	5.7
18	9.6	1850	13.2	0545	6.1
19	9.9	1715	12.6	0630	7.4
20	10.4	1725	13.9	0625	7.1
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	9.0	1929	12.3	0539	5.7
25	11.3	1629	14.9	0549	8.1
26	9.7	1644	12.4	0649	7.5
27	10.7	1824	14.7	0539	7.0
28	12.7	1719	16.2	0639	9.4
29	13.0	1349	15.9	0549	9.9
30	13.6	1659	17.3	0604	10.2
AVERAGE	9.7		12.8		6.7
MAXIMUM	13.6		17.3		10.2
MINIMUM	6.7		9.1		2.7

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

JULY 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	14.0	1724	17.4	0559	10.7
2	14.2	1619	17.9	0614	10.6
3	15.7	1709	19.9	0544	11.9
4	15.2	1629	18.6	0554	12.3
5	15.2	1719	19.1	0554	11.6
6	15.7	1754	19.3	0609	12.2
7	11.2	0004	16.7	2354	8.1
8	7.4	1604	8.2	2354	6.1
9	6.2	1659	7.4	0544	5.3
10	6.9	1614	8.8	0529	5.5
11	8.9	1644	13.1	0534	5.6
12	11.4	1704	15.9	0554	7.2
13	11.4	1839	14.3	0614	9.5
14	12.9	1449	17.0	0724	9.9
15	13.5	1529	17.0	0724	11.0
16	12.6	1459	14.8	0514	10.6
17	11.7	1929	12.7	2359	11.1
18	12.8	1614	15.8	0454	10.5
19	13.0	1729	16.0	0449	10.5
20	13.4	1729	15.6	0439	11.4
21	12.8	1534	14.1	2359	11.5
22	12.0	1639	15.1	0954	10.5
23	13.4	1644	17.2	0534	10.0
24	11.4	1349	14.7	2359	9.2
25	8.9	1554	10.0	0539	7.7
26	10.0	1629	13.9	0444	7.3
27	9.4	1454	13.1	0514	6.7
28	8.3	1539	10.1	0624	7.0
29	9.2	1644	13.4	0534	7.1
30	9.7	1719	13.3	0529	7.6
31	9.3	1649	13.6	0419	6.5
AVERAGE	11.5		14.6		9.1
MAXIMUM	15.7		19.9		12.3
MINIMUM	6.2		7.4		5.3

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

AUGUST 1990

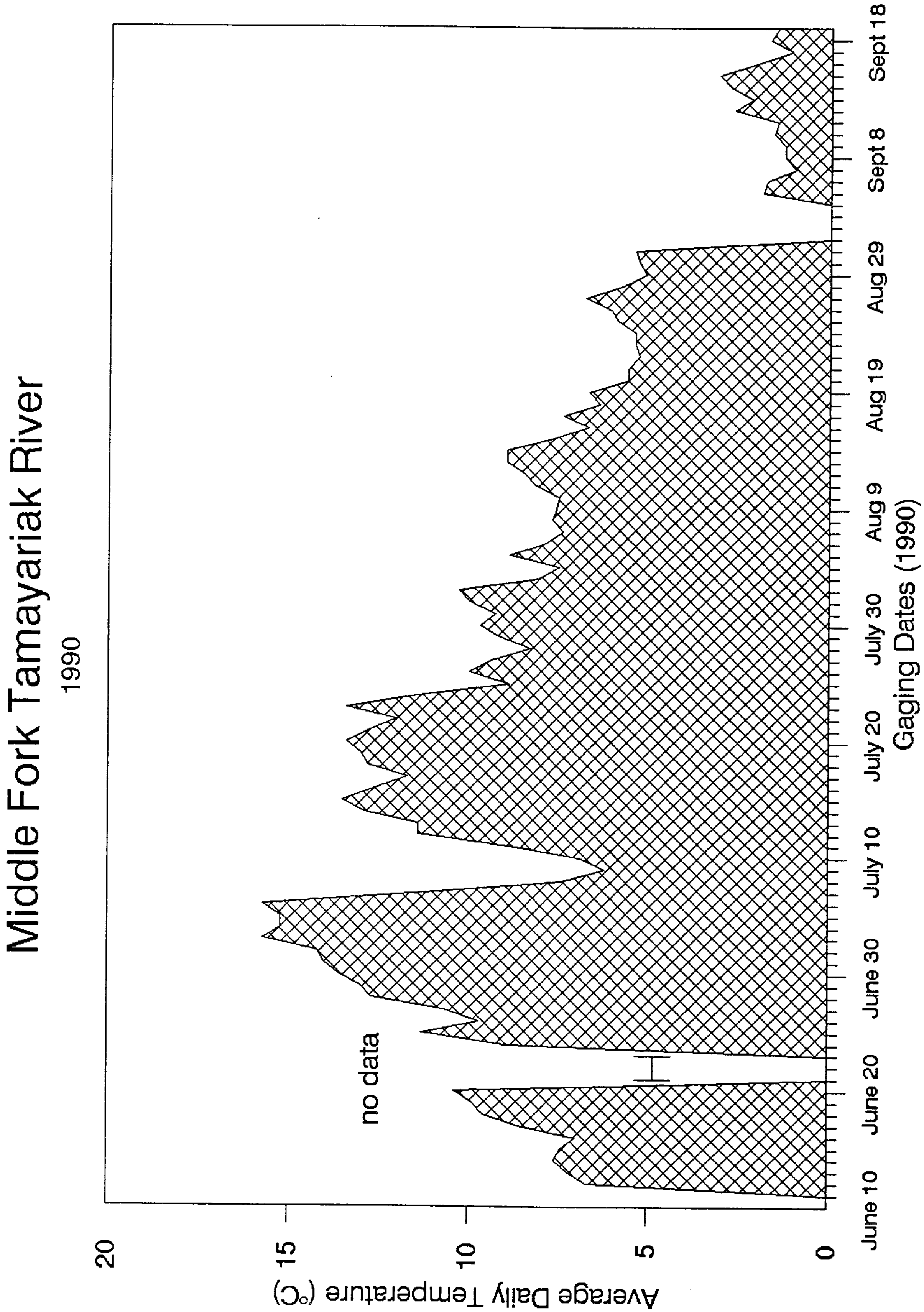
DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	10.0	1629	14.7	0459	6.1
2	10.3	1514	14.3	0609	7.4
3	8.1	1609	8.8	2359	7.2
4	7.5	1509	9.8	0434	5.4
5	8.9	1514	13.0	0709	5.8
6	7.9	1719	10.1	0419	6.3
7	7.4	1754	9.0	0454	6.0
8	7.7	1744	9.9	0614	6.0
9	7.6	1634	9.9	0609	6.0
10	7.5	1634	10.1	0414	5.8
11	8.2	1454	12.6	0549	5.5
12	8.5	1554	13.5	0624	4.6
13	9.0	1539	13.2	0554	6.6
14	9.0	1524	13.1	0614	6.7
15	7.7	1644	10.6	2359	6.0
16	6.7	1719	8.1	2359	5.4
17	7.4	1544	11.6	0239	5.0
18	6.4	1704	7.9	0119	5.4
19	6.7	1519	10.1	2359	4.8
20	5.6	1624	8.1	0429	4.2
21	5.6	1614	8.7	0649	3.3
22	5.3	1514	10.6	0639	1.0
23	5.4	1519	9.5	0739	1.9
24	5.4	1324	9.4	0714	1.9
25	5.9	1539	9.7	0814	3.5
26	6.1	1529	11.6	0524	3.0
27	6.8	1729	7.9	2359	5.8
28	5.8	1239	7.4	0629	4.7
29	5.1	1704	6.1	0719	4.5
30	5.3	1544	6.8	0144	4.3
31	5.4	1904	7.0	0649	4.4
AVERAGE	7.1		10.1		5.0
MAXIMUM	10.3		14.7		7.4
MINIMUM	5.1		6.1		1.0

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

SEPTEMBER 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	1.9	1224	6.0	0319	0.1
6	1.8	1524	2.5	0019	0.6
7	1.0	1839	1.8	0814	0.1
8	1.3	1439	2.1	0714	0.8
9	1.3	1729	3.1	0804	0.1
10	1.6	1719	3.8	0629	0.3
11	1.5	1554	3.3	0519	0.0
12	2.7	1709	4.9	0749	1.2
13	2.2	1739	4.8	0754	0.0
14	2.8	1649	4.1	0739	1.5
15	3.1	1744	3.9	0834	2.1
16	2.1	1659	4.2	0834	0.4
17	1.1	1629	2.3	0809	0.2
18	1.7	1644	3.6	0104	0.4
19	1.5	1619	2.0	0844	1.0
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	1.8		3.5		0.6
MAXIMUM	3.1		6.0		2.1
MINIMUM	1.0		1.8		0.0



Middle Fork Tamayariak River
1990
no data
Average Daily Temperature (°C)
0
5
10
15
20
June 10
June 20
June 30
July 10
July 20
July 30
Aug 9
Aug 19
Aug 29
Sept 8
Sept 18
Gaging Dates (1990)

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, UPPER WEST FORK

LOCATION.--Lat 69°49'58", long 145°55'15", in the center W½W½ sec 33, T.6N., R.25E., 13.9 miles upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--49.2 mi², of which 5.6 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREME FOR PERIOD OF RECORD.--Maximum Temperature, 20.7°C July 5, 1990.

JUNE 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	- - -	- - -	- - -	- - -	- - -
2	- - -	- - -	- - -	- - -	- - -
3	- - -	- - -	- - -	- - -	- - -
4	- - -	- - -	- - -	- - -	- - -
5	- - -	- - -	- - -	- - -	- - -
6	- - -	- - -	- - -	- - -	- - -
7	- - -	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -	- - -
9	- - -	- - -	- - -	- - -	- - -
10	- - -	- - -	- - -	- - -	- - -
11	- - -	- - -	- - -	- - -	- - -
12	7.3	1718	11.4	0613	3.5
13	8.4	1603	10.5	0628	6.6
14	8.9	1808	12.1	0618	6.0
15	9.0	1328	11.2	0648	7.5
16	8.5	2108	10.3	0538	6.6
17	10.1	1803	13.7	0853	7.1
18	11.5	1918	13.9	0603	8.8
19	11.4	1713	13.3	0548	9.6
20	11.5	1918	13.6	0538	9.0
21	10.6	1923	12.1	0528	9.3
22	12.2	1723	15.5	0628	9.0
23	10.5	0008	13.4	2353	8.7
24	10.2	1938	13.2	0628	7.4
25	12.6	1743	15.8	0623	9.5
26	12.3	1723	14.7	0838	10.2
27	12.6	1843	15.5	0628	10.0
28	14.4	1633	17.1	0538	12.2
29	14.5	1428	16.4	0553	12.4
30	15.3	1808	18.4	0558	12.4
AVERAGE	11.1		13.8		8.7
MAXIMUM	15.3		18.4		12.4
MINIMUM	7.3		10.3		3.5

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, UPPER WEST FORK

JULY 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN TEMP DEG C
1	16.0	1803	18.5	0638	13.3
2	16.1	1803	18.7	0643	13.7
3	16.6	1933	19.5	0533	14.6
4	17.1	1743	19.6	0553	15.2
5	17.5	1758	20.7	0623	15.1
6	17.4	1913	19.7	0643	15.5
7	15.1	0003	18.5	2343	11.0
8	9.4	0038	11.2	2353	7.5
9	7.3	1738	8.1	0648	6.6
10	8.0	1458	9.1	0428	6.9
11	9.5	1848	12.6	0603	7.2
12	10.9	1908	13.7	0523	8.7
13	12.2	1823	14.8	0618	11.1
14	13.5	1523	15.8	0728	12.0
15	14.1	1708	16.2	0713	13.0
16	13.5	1623	14.6	0708	12.5
17	12.8	0013	13.5	0523	12.4
18	12.8	1938	14.5	0433	11.9
19	13.6	1158	14.8	0523	12.5
20	14.0	1858	15.5	0433	12.8
21	13.8	1713	14.7	2338	13.0
22	13.1	1753	14.7	0843	12.3
23	13.6	1543	15.9	0633	11.9
24	12.9	1523	15.2	2358	11.4
25	10.4	0003	11.3	2358	9.3
26	9.7	1723	11.7	0618	8.4
27	9.0	1628	10.7	0558	7.6
28	8.7	1613	10.2	0738	7.8
29	9.0	1843	10.8	0513	7.9
30	9.7	1728	12.1	0738	8.3
31	9.7	1758	11.8	0528	8.4
AVERAGE	12.5		14.5		11.0
MAXIMUM	17.5		20.7		15.5
MINIMUM	7.3		8.1		6.6

ARCTIC NATIONAL WILDLIFE REFUGE

TAMAYARIAK RIVER, UPPER WEST FORK

AUGUST 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN DISCH.
1	9.0	1948	11.4	0638	7.8
2	10.4	1753	13.2	0633	8.6
3	9.3	0003	10.4	0928	8.8
4	8.6	1733	9.6	2358	7.8
5	8.8	1823	11.8	0853	6.8
6	9.4	1633	11.9	0843	7.7
7	9.0	1723	10.5	0918	8.0
8	8.6	1948	9.5	0843	7.9
9	8.3	2008	9.9	0743	7.6
10	8.5	1908	10.5	0858	7.5
11	8.1	2103	10.3	1043	7.2
12	7.9	2218	9.3	0803	6.9
13	9.4	1853	12.4	1008	7.6
14	9.5	2123	10.8	0843	8.5
15	9.6	1913	10.9	0948	8.7
16	8.7	2038	9.6	1023	8.2
17	8.9	1903	11.0	0858	7.6
18	8.3	0003	9.4	1038	7.6
19	7.9	1723	9.4	0918	7.0
20	6.6	0003	7.3	2358	6.1
21	6.0	1823	7.3	0903	5.2
22	5.6	1903	7.2	0938	4.2
23	5.6	1833	7.3	1018	4.2
24	5.3	1928	6.2	0918	4.3
25	5.5	1858	6.9	0808	4.4
26	5.8	1818	7.2	0703	4.9
27	7.0	1753	7.5	1023	6.6
28	6.3	0003	6.9	2358	5.8
29	5.0	0003	5.8	0903	4.4
30	4.8	1828	5.5	0613	4.1
31	5.2	1613	6.0	0803	4.5
AVERAGE	7.6		9.1		6.7
MAXIMUM	10.4		13.2		8.8
MINIMUM	4.8		5.5		4.1

ARCTIC NATIONAL WILDLIFE REFUGE

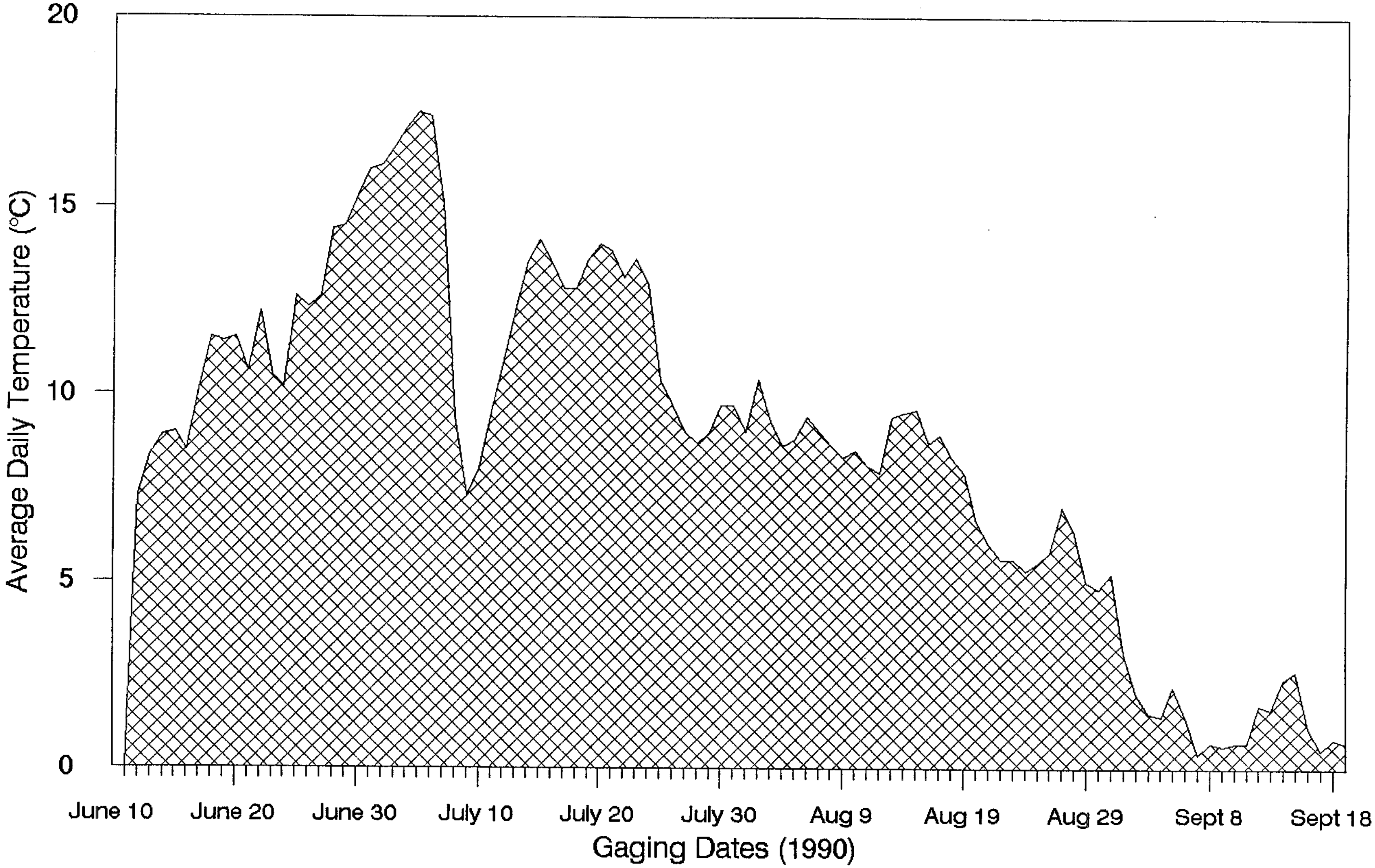
TAMAYARIAK RIVER, UPPER WEST FORK

SEPTEMBER 1990

DATE	AVG TEMP DEG C	TIME OF MAX TEMP	MAX TEMP DEG C	TIME OF MIN TEMP	MIN DISCH. CU. FT/SEC
1	3.1	0003	5.1	2358	2.1
2	2.0	1703	3.6	0713	0.7
3	1.5	1653	3.5	0623	-0.1
4	1.4	1738	2.8	0803	0.1
5	2.2	1713	3.9	0738	0.8
6	1.4	0003	2.6	2338	0.6
7	0.4	1853	1.0	0733	-0.1
8	0.7	1743	1.5	0743	0.1
9	0.6	1748	1.7	1038	0.0
10	0.7	1803	2.0	0758	0.0
11	0.7	1738	1.8	1138	0.1
12	1.7	1833	3.5	0808	0.5
13	1.6	1908	3.1	1008	0.3
14	2.4	1838	3.6	0818	1.3
15	2.6	0003	3.3	2358	1.4
16	1.1	1753	2.7	0918	0.0
17	0.5	1738	1.2	1028	0.0
18	0.8	1753	2.3	0933	0.0
19	0.7	1743	1.2	0943	0.2
20	- - -	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -
22	- - -	- - -	- - -	- - -	- - -
23	- - -	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -
25	- - -	- - -	- - -	- - -	- - -
26	- - -	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -
29	- - -	- - -	- - -	- - -	- - -
30	- - -	- - -	- - -	- - -	- - -
AVERAGE	1.4		2.7		0.4
MAXIMUM	3.1		5.1		2.1
MINIMUM	0.4		1.0		-0.1

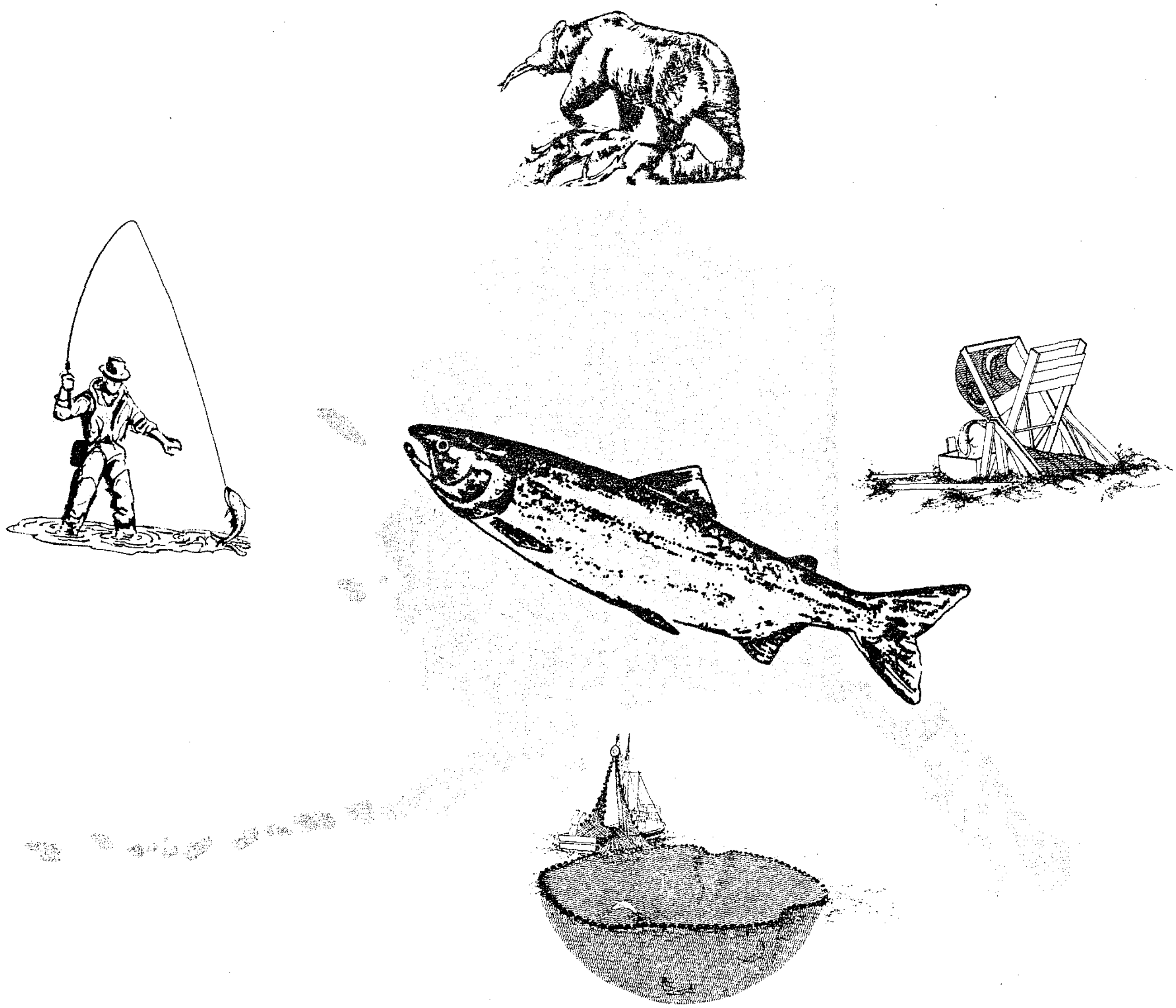
Upper West Fork Tamayariak River

1990



WATER RESOURCE INVENTORY AND ASSESSMENT, ARCTIC NATIONAL WILDLIFE REFUGE, 1991 STREAM DISCHARGE GAGING DATA

Alaska Fisheries Progress Report Number 92-2



March 1992

Region 7

U.S. Fish and Wildlife Service • Department of the Interior

WATER RESOURCE INVENTORY AND ASSESSMENT

ARCTIC NATIONAL WILDLIFE REFUGE

1991 Stream Discharge Gaging Data

Alaska Fisheries Progress Report

Steven M. Lyons
John M. Trawicki

Fisheries Management Services
Water Resource Branch
U.S. Fish and Wildlife Service
Department of the Interior
Anchorage, Alaska

March 1992

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Table of Contents

1991 STREAM DISCHARGE

Introduction

This progress report documents the accomplishments of the fourth year of a multi-year water resource inventory on the coastal plain (1002 area) of the Arctic National Wildlife Refuge (ANWR). This progress report is intended to provide stream discharge and water temperature data for consideration in other inventory or management activities. These data represent the hydrologic conditions for the 1991 summer season.

The 1002 area of the Arctic National Wildlife Refuge is located in the remote northeast corner of Alaska adjacent to the Beaufort Sea. Because of the remoteness, extreme climatic conditions, small populace, and lack of competitive water use in the past, there has been little interest in the water resources (water yields, discharge rates, flood frequencies, etc.) from state, federal, or private agencies. The nearest stream gaging station (U.S. Geological Survey gage #15908000, Sagavanirktok River) is located 80 miles west of the Canning River, the western boundary of the 1002 area. The Sagavanirktok River is larger than any river in the 1002 area. Therefore the Sagavanirktok River database cannot be extrapolated to provide discharge and flood information for the rivers in the 1002 area.

Hydrologic data for the 1002 area are limited. Childers et al. (1977) reported a reconnaissance level investigation of rivers, springs, aufeis fields, and lakes of the Arctic coastal plain including the 1002 area. Childers et al. (1977) reported data on channel characteristics, watershed characteristics, and estimated flood characteristics of the Canning River, Marsh Creek, Sadlerochit River, Hulahula River, Jago River, and Okerokovik River. Childers et al. (1977) also reported discharge rates and selected water quality parameters for the Katakturuk River Springs, Sadlerochit Springs, Hulahula River Spring, and Okerokovik River Springs. Six lakes were sampled for water quality, ice thickness, and water depth.

Daum et al. (1984), Glesne and Deschermeier (1984), and Smith and Glesne (1982) reported selected physical and chemical characteristics of streams and springs across the 1002 area. Elliott and Lyons (1990) reported on the availability of winter water within stream systems within the 1002 area. A study of the quantity and distribution of water within lakes of the 1002 area was conducted and reported by Elliott (1990), and Trawicki et al. (1991).

There are no precipitation gages located within the 1002 area. The closest precipitation gage is located on Barter Island, and is operated by the U.S. Soil Conservation Service (SCS). The SCS maintains six other precipitation gages in the Arctic region located at: Atigun Camp, Atigun Pass, Barrow, Pruhdoe Bay, Sagwon, and Toolik River. The National Oceanic and Atmospheric Administration (NOAA) maintains seven weather stations in the Arctic region. The data collected from these gages are not representative of precipitation events that occur in the drainage basins of the 1002 area. A combination of data from the SCS stations located in the general vicinity of the 1002 area indicate near average precipitation during the winter months and slightly

below (0-10%) the longterm average precipitation during the summer months (SCS 1990 and unpublished data).

U.S. Fish and Wildlife Service (1989), Lyons (1990), and Lyons and Trawicki (1991) collected and reported discharge and water temperature data for several rivers and streams in the 1002 area for the summers of 1988, 1989, and 1990, respectively. This progress report is a continuation of these studies. The objectives of the 1991 activities were to continue the quantification of water yield and seasonal stream discharge, and to measure stream water temperatures of watersheds within the 1002 area of the ANWR. At the conclusion of the multi-year water resource inventory, stream discharge rates, discharge frequency distributions, average monthly water yields, and flood frequencies and sizes will be quantified.

Methods

The Water Resources Branch initiated a stream gaging network consisting of eight gaging stations in the 1002 area in 1988. In 1989 the stream gaging network was expanded to 10 gaging stations (Figure 1). The new gaging stations were located on the Niguanak River and Sikrelurak River. Stream discharge data were collected for the Tamayariak River, West Fork of Itkilyariak Creek, Sadlerochit River, Sadlerochit Spring Creek, Akutoktak River, Niguanak River, and Sikrelurak River. Table 1 contains the legal description of the location of each stream gage. Since the Tamayariak River is a hydrologically diverse system with abundant fish and wildlife resources, four stream gages were installed on this watershed.

Water depths and temperatures were measured at all ten stream gaging stations in 1991. A pressure transducer and temperature thermistor was attached to an anchor and placed on the stream bottom at each gaging station. A cable connected the pressure transducer and temperature thermistor to a computerized field recorder located along the river bank. The field recorder took depth and temperature readings at five minute intervals. Water depths were measured to the nearest 0.01 ft, and water temperatures were measured to the nearest 0.1°C. The field recorder summarized the five minute interval data automatically for each 24 hour period into a report that included: average depth, maximum depth, time of maximum depth, minimum depth, time of minimum depth, average temperature, maximum temperature, time of maximum temperature, minimum temperature, and time of minimum temperature. The summarized data were stored on a data storage pack, and summerized data were later down-loaded onto a computer.

Calibration data were collected at each gaging station on a weekly basis. More frequent visits were made to gaging stations during extreme high and low flow periods to increase the range of calibration data collected. Calibration data were collected using standard stream discharge measurement procedures (Buchanan and Somers 1969, and Lyons 1988) and included stream discharge in cubic feet per second (cfs), water depth, and water surface elevation.

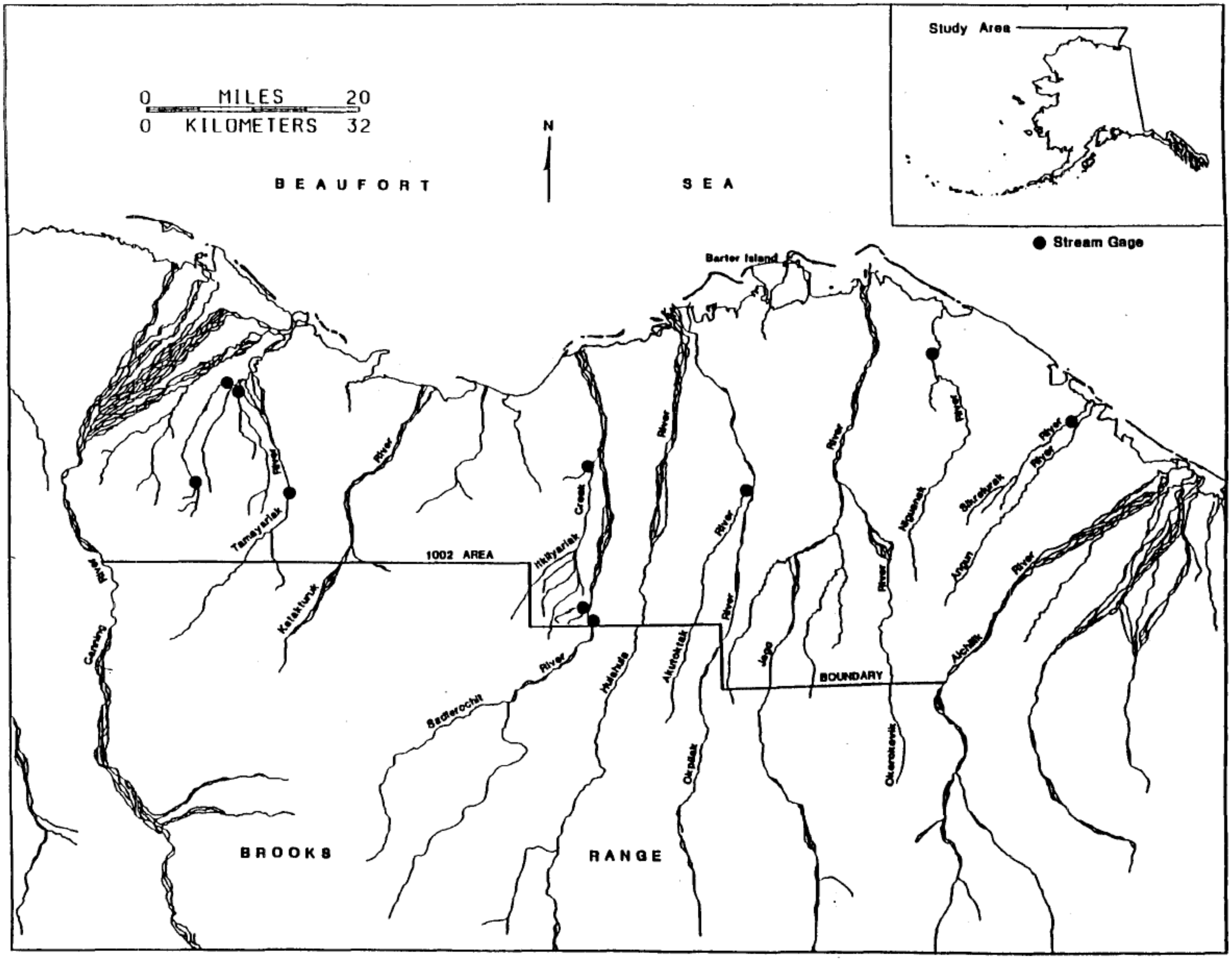

Figure 1.-The 1002 area of the Arctic National Wildlife Refuge with stream discharge gaging station locations.

Table 1.-Stream gaging station locations.

Watershed	Gage Location
Akutoktak River	Center Sec. 36, T6N, R33E
West Fork, Itkilyariak Creek	NE¼ NW¼ NW¼ Sec. 33, T6N, R31E
Niguanak River	NW¼ NW¼ NE¼ Sec. 36, T8N, R36E
Sadlerochit River	NW¼ SW¼ Sec. 31, T4N, R32E
Sadlerochit Spring Creek	NE¼ NW¼ Sec. 36, T4N, R31E
Sikrelurak River	SE¼ SE¼ Sec. 36, T7N, R38E
Tamayariak River	SW¼ NE¼ Sec. 35, T6N, R26E
Lower West Fork, Tamayariak River	NW¼ NW¼ Sec. 12, T7N, R25E
Middle Fork, Tamayariak River	Center Sec. 12, T7N, R25E
Upper West Fork, Tamayariak River	W½ W½ Sec. 33, T6N, R25E

Through regression analysis of water depth (x) and stream discharge (y), a linear or polynomial regression equation was obtained for each stream gage. Using the regression equations, water depth data were converted to stream discharge for each stream gaging station.

Average daily discharge was estimated for gaging stations that experienced technical problems during the stream gaging period. For a single missing data point, the missing data point was estimated by averaging the data point from the day prior to and the day following the missing data point. For small data gaps (2-5 days), data points were estimated using the average rate of change in discharge from several streams with similar watershed characteristics. For larger data gaps, a linear relationship was established between the stream with missing data and a stream with similar watershed characteristics and discharge rates. The relationship was established from the average daily discharge for all days that the two streams had records in common. The linear relationship was used to estimate the missing average daily discharge of one stream from the known average daily discharge of the other stream. Where no relationship could be established between two rivers the data gap was left as missing data.

Peak storm discharge was estimated for gaging stations that were damaged or destroyed during a flood event. Peak storm discharge was estimated by surveying the elevation of the high water mark with respect to the benchmark at the gaging station. From the survey, the water depth at the peak of the storm discharge was calculated. The water depth was entered into the regression equation for the gaging station, allowing the peak storm discharge to be calculated.

Results

Stream gaging stations were installed on June 4, 1991, on the Akutoktak River, Niguanak River, Sadlerochit River, Sadlerochit Springs Creek, Sikrelurak River, Tamayariak River and the Middle Fork Tamayariak River. Ice conditions on the West Fork Itkilyariak Creek and Lower West Fork Tamayariak River delayed stream gage installation until June 7, 1991. Ice conditions on the Upper West Fork Tamayariak River prevented stream gage installation at this location until June 20, 1991. All stream gaging stations were in service until September 24, 1991.

Calibration data were collected from June 13 through September 10. Using the calibration data, polynomial regression equations were obtained for each stream gaging station, except Sadlerochit Springs gaging station. No regression equation was obtained for the Sadlerochit Springs gaging station due to unreliable readings from the field recorder.

Flooding in late July altered the cross sectional area at stream gaging stations located on the Akutoktak River, West Fork Itkilyariak Creek, Sadlerochit River, Tamayariak River, Lower West Fork Tamayariak River, Middle Fork Tamayariak River, and the Upper West Fork Tamayariak River. Due to the altered cross-sectional areas, a second (post-flood) set of calibration data were collected. Utilizing the pre- and post-flood regression equations (Table 2), water depth measurements recorded with the stream gaging equipment were converted to stream discharge (Appendix A). The Niguanak and Sikrelurak Rivers were not affected by the July flood, and therefore single regression equations were used for the entire data sets from these two gaging stations.

The average daily discharge of the Tamayariak River 1988-1991 (Figure 2) clearly shows the highlights of the 1991 stream gaging period and the large variability in discharge records among the four years of record. Note the early installation of the stream gage, the high discharge measurements associated with the early stream gage installation, and the estimated maximum discharge associated with the July flood.

Flooding in late July was extreme during the 1991 stream gaging season. Heavy rains and rapidly rising rivers were reported by field crews camped in the foothills along the Sadlerochit River. Stream gaging equipment on the West Fork Itkilyariak River, Sadlerochit River, and the Lower West Fork Tamayariak River were damaged during the flood. The Tamayariak River stream gaging station was completely washed away. The field recorder was found 0.5 mile downstream after the river subsided. The pressure transducer, temperature thermistor, and anchor were never recovered. The July 1991 flood produced record breaking extreme maximum discharges for the four years of record on the Sadlerochit River (21,000 cfs; estimated), Tamayariak River (5,200 cfs; estimated) and the Lower West Fork Tamayariak River (1,433 cfs).

Ice conditions and high water made stream gage installation difficult. Stream gaging stations were installed just after breakup, during the high spring breakup flow. This was the earliest that stream gaging stations were

Table 2.-Regression equations from stream discharge calibration data, where x = water depth (ft) and y = stream discharge (cfs).

Watershed	Regression Equation	R^2
Akutoktak River	$y_a = 151.5 - 57.9x - 48.1x^2 + 19.7x^3$	0.99
	$y_b = 245.6 - 178.0x + 2.1x^2 + 13.1x^3$	0.99
West Fork Itkilyariak Creek	$y_a = 28.6 - 77.8x + 72.7x^2 - 9.2x^3$	0.99
	$y_b = 120.6 - 197.5x + 80.9x^2$	0.99
Niguanak River	$y_c = 3030.0 - 2356.8x + 556.3x^2 - 35.7x^3$	0.99
Sadlerochit River	$y_a = 1361.3 - 1283.5x + 413.3x^2$	0.99
	$y_b = -79.8 + 515.0x - 173.1x^2 + 80.6x^3$	0.99
Sadlerochit Springs Creek	no equation	
Sikrelurak River	$y_c = -105.9 + 217.7x - 169.2x^2 + 57.0x^3$	0.99
Tamayariak River	$y_a = 513.0 - 823.9x + 343.5x^2$	0.99
	$y_b = -3369.0 + 3928.7x - 1527.2x^2 + 203.9x^3$	0.99
Lower West Fork Tamayariak River	$y_a = 249.4 - 176.5x + 10.7x^2 + 8.2x^3$	0.99
	$y_b = 426.5 - 372.2x + 82.5x^2$	0.99
Middle Fork Tamayariak River	$y_a = -251.3 + 391.4x - 224.2x^2 + 49.5x^3$	0.99
	$y_b = 132.7 - 200.9x + 79.4x^2$	0.99
Upper West Fork Tamayariak River	$y_a = -4093.1 + 3377.1x - 943.2x^2 + 89.8x^3$	0.99
	$y_b = 138.4 - 166.5x + 38.8x^2 + 7.6x^3$	0.99

y_a= Pre-flood regression equation.
y_b= Post-flood regression equation.
y_c= Entire season regression equation.

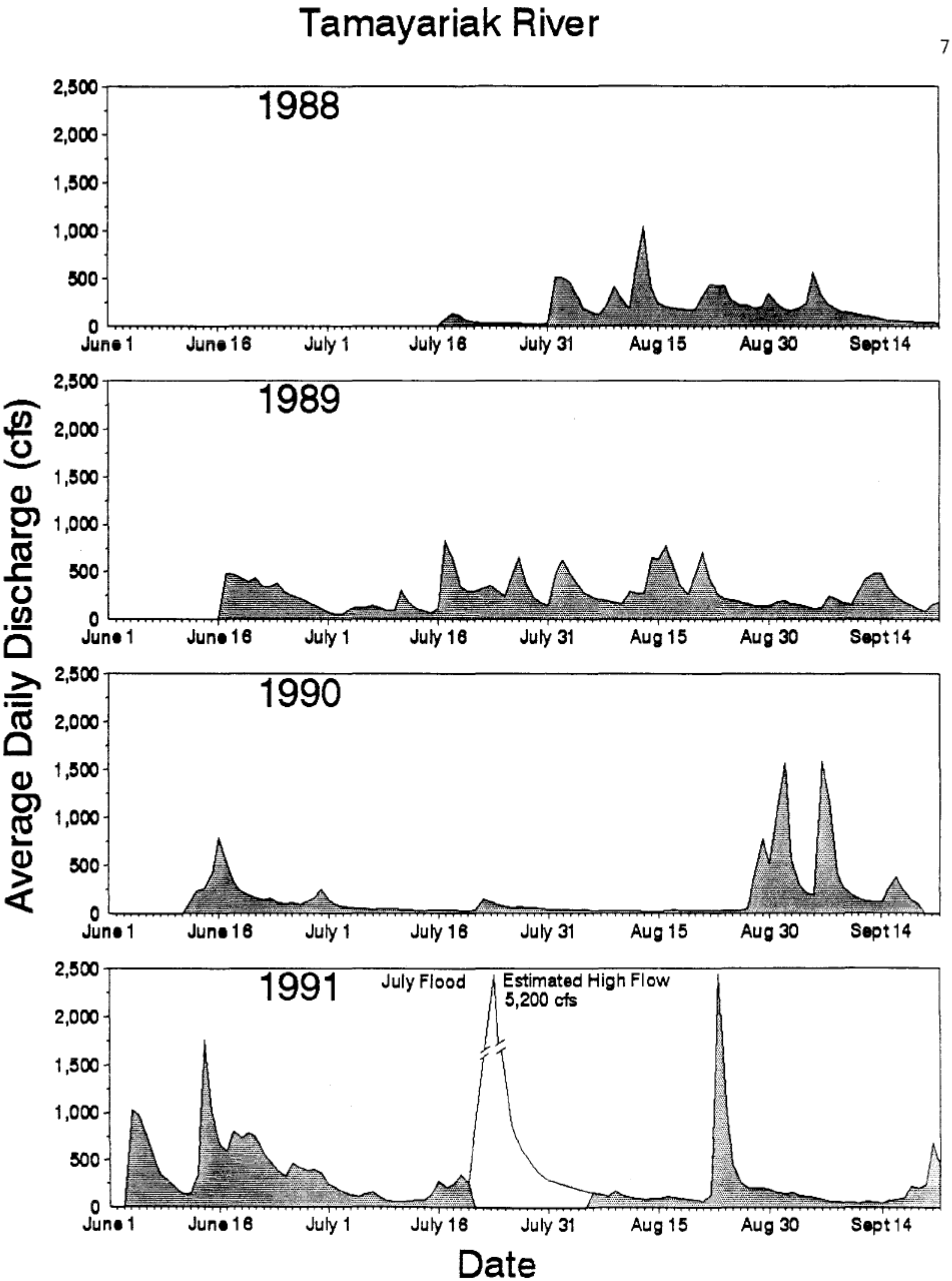

Figure 2.-Comparison of discharge records for the Tamayariak River for the four years of record, 1988-1991.

operating with respect to breakup. The early stream gage installation yielded extreme maximum discharge records of 1,867 cfs to be set on the Middle Fork Tamayariak River, and 1,787 cfs on the Sikrelurak River on June 4, 1991.

Two extreme minimum flow records were also set. Both minimum flow records were set in conjunction with the low flows and cold water temperatures that occur just before freeze-up. Extreme minimum discharge records of 39 cfs and 8.3 cfs were recorded on the Sadlerochit River on September 15, 1991, and on the Tamayariak River on September 14, 1991 respectively. Extreme minimum discharge records of 0 cfs on the Sikrelurak River during September 6-8, 1991, tie minimum discharge records set in 1989 and 1990.

Water temperature measurements taken from all gaging stations except Sadlerochit Springs are given in Appendix B. The daily average water temperature as well as the maximum and minimum temperatures and the time of each are provided.

Equipment malfunction, and damage or movement of field recorders, pressure transducers and temperature thermistors due to flooding resulted in data gaps at several stream gaging stations throughout the gaging period (Table 3). Field recorders stopped logging data on the Niguanak River, Lower West Fork Tamayariak River, and the Middle Fork Tamayariak River. Field recorders were replaced and average daily discharge estimates were made for the missing data. Although the field recorder at the Sadlerochit Springs Creek gaging station was operating the entire season, the water depth data from the field recorder were inconsistent and considered to be unreliable. The entire Sadlerochit Springs Creek data set was discarded. High water during breakup and the July flood caused data gaps on the West Fork Itkilyariak Creek (16 days; 2 events), Sadlerochit River (14 days), Tamayariak River (16 days), and the Upper West Fork Tamayariak River (1 day). Average daily discharge estimates were made for data gaps on the West Fork Itkilyariak Creek (3 days, 1 event) and the Upper West Fork Tamayariak River. No relationships could be established to estimate the remainder of the missing discharge data.

Discussion

Fiscal year 1991 was the fourth year of a multi-year water resource inventory program designed to quantify stream discharge rates, discharge frequency distribution, average monthly water yields, and flood frequencies and sizes within the 1002 area of the Arctic National Wildlife Refuge. Figure 2 shows the extreme variability in discharge data for the four years of record and illustrates the need of several years of discharge data before quantification of drainage basin characteristics can be made.

The closest river with a long record of discharge measurements is the Sagavanirktok River. The Sadlerochit and Tamayariak Rivers are the largest rivers with gaging stations in the 1002 area. A comparison of the average daily discharge of the Sadlerochit (R^2=0.48) and Tamayariak (R^2=0.22) rivers

Table 3.-Summary of missing 1991 stream discharge and temperature data.

Gage Location	No. Days	Dates of Missing Data	Remarks
West Fork Itkilyariak Creek	3	6/15-6/17	Debris pulled pressure transducer from anchor. Discharge data were estimated. No temperature data were lost.
	13	7/22-8/3	Field recorder was flooded. Discharge and temperature data were lost.
Niguanak River	3	6/4-6/6	Field recorder malfunctioned and was replaced. Discharge and temperature data were lost.
	6	6/07-6/12	Field recorder malfunctioned. Data storage pack was replaced. Discharge and temperature data were lost.
	3	9/22-9/24	Pressure transducer malfunctioned. Discharge data were estimated. No temperature data were lost.
Sadlerochit River	14	7/21-8/4	Debris pulled pressure transducer from anchor during flood event. Peak storm discharge was estimated. Discharge data were lost. No temperature data were lost.
Sadlerochit Springs	110	6/7-9/24	Unreliable probe readings. Data were discarded.
Tamayariak River	16	7/21-8/5	Flood washed out gaging station. Peak storm discharge was estimated. Discharge and temperature data were lost. Gaging station equipment was lost or destroyed.
Lower West Fork Tamayariak River	2	7/23-7/24	Field recorder stopped logging data and had to be replaced. Discharge data were estimated. Temperature data were lost.
Middle Fork Tamayariak River	3	8/11-8/13	Field recorder stopped logging data and had to be replaced. Discharge data were estimated. Temperature data were lost.
Upper West Fork Tamayariak River	1	8/5	Anchor and probes were reset because flood altered channel and stream bottom. Discharge datum was estimated.

to the Sagavanirktok River for 1988, 1989, and 1990 were unsuccessful. The Sagavanirktok River is a much larger drainage system than any drainage within the 1002 area and a strong correlation was not expected.

Early installation of stream gaging stations in 1991 provided additional discharge information for the breakup period that has previously not been recorded. The 1991 data still do not cover the entire breakup process. Due to the extreme conditions that exist prior to and during breakup, stream gaging stations cannot be installed until the river channel is free of anchor ice. This accounts for the limited documentation of discharge measurements during the breakup period.

Seven new extremes for the period of record were set during the 1991 gaging season. Record breaking maximum discharges were recorded in conjunction with breakup on the Sikrelurak River and Middle Fork Tamayariak River. Maximum record breaking discharges were recorded during the July flood on the Sadlerochit, Tamayariak and Lower West Fork Tamayariak Rivers. Two record breaking minimum flow records were set just prior to freeze up on the Sadlerochit and Tamayariak rivers. Low flows in mid September on the Sikrelurak River tied the extreme low flow record (0 cfs) set in 1989 and 1990.

The two largest rivers with gaging stations (Sadlerochit and Tamayariak Rivers) recorded record high and record low discharges during the 1991 gaging season. Overall discharge for the 1991 gaging season was between the continuous high flow season of 1989 and the extended low flow season of 1990.

Estimates of missing data were made for small data gaps or where a strong relationship between discharge from two streams was found. As additional data are collected these relationships should improve and missing discharge records may be estimated.

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Appendix A

Surface Water Discharge Records

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

LOCATION.--Lat 60°49'58", long 143°46'50", in center sec. 36, T.6N., R.33E., 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--97.1 mi², of which 66.0 mi² is located within the Arctic National Wildlife Refuge Wildernes Area.

PERIOD OF RECORD.--July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,703 cfs Aug. 20, 1989 @ 2350 hrs; Minimum Discharge, 0.7 cfs Aug. 18, 1990.

JUNE 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -		- - -		- - -
2	- - -		- - -		- - -
3	- - -		- - -		- - -
4	566	0003	746	1343	467
5	395	0153	566	2358	264
6	194	0003	264	2358	144
7	124	0028	147	2358	90
8	73	0218	92	2338	59
9	50	0008	61	2358	43
10	40	0718	51	2358	33
11	31	2318	37	0733	28
12	58	2358	152	0003	35
13	308	2358	410	0003	152
14	597	1848	768	0003	400
15	451	0013	669	2358	362
16	296	0008	366	1458	268
17	284	2323	371	1138	242
18	348	1948	395	0923	292
19	256	0013	376	1353	214
20	227	0113	264	1218	197
21	169	0033	227	1803	144
22	124	0058	169	2358	92
23	76	0003	92	1353	71
24	64	0003	73	2353	53
25	43	0003	53	1113	39
26	53	2358	128	0628	35
27	163	0423	191	0003	131
28	100	0013	141	2358	76
29	61	0228	76	2353	47
30	46	0558	56	2243	40
TOTAL	5197		- - -		- - -
AVERAGE	192		257		149
MAXIMUM	597		768		467
MINIMUM	31		37		28
ACRE FT	10308		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

JULY 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	62	1023	73	0013	42
2	50	0023	61	2358	39
3	32	0028	40	2358	25
4	22	0003	25	2358	18
5	14	0003	18	2018	13
6	10	0018	13	1753	8.7
7	8.7	0023	9.8	1603	7.6
8	7.1	0028	8.7	2353	5.3
9	4.9	0003	5.3	2353	4.1
10	4.5	1603	4.5	0318	3.8
11	3.8	0013	4.1	2358	3.8
12	3.8	1258	4.5	0633	3.4
13	3.8	0003	4.1	2043	3.4
14	3.8	0733	4.5	1853	2.8
15	3.1	2358	3.8	0003	2.8
16	4.5	0823	5.3	2003	3.4
17	3.8	0243	4.9	1908	2.8
18	3.8	0618	4.1	2303	3.1
19	53	0948	82	0003	3.4
20	44	0008	64	2353	30
21	37	1933	39	0408	33
22	60	2358	134	0213	38
23	314	1318	433	0003	136
24	236	0013	338	2353	168
25	122	0013	168	2353	90
26	71	0008	90	2358	55
27	47	0003	55	2358	38
28	36	0008	38	1753	34
29	33	0323	37	2328	29
30	29	2353	34	1433	28
31	63	1608	76	0008	34
TOTAL	1389		- - -		- - -
AVERAGE	45		61		29
MAXIMUM	314		433		168
MINIMUM	3.1		3.8		2.8
ACRE FT	2755		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

AUGUST 1991

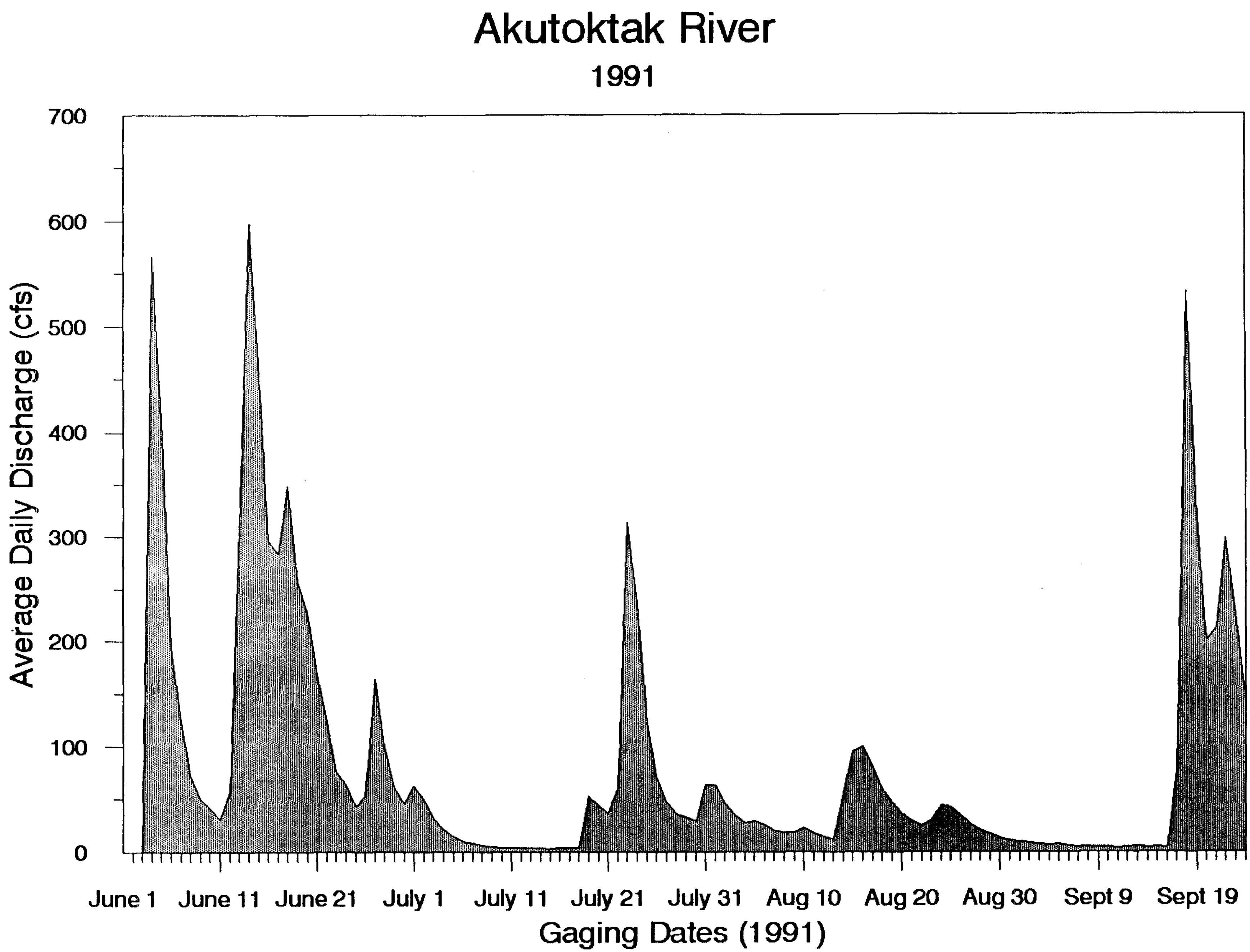
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	63	0018	73	2358	54
2	45	0013	54	2343	38
3	34	0003	39	2353	30
4	28	0003	30	2318	27
5	29	2033	31	0413	27
6	26	0158	31	2218	22
7	20	0033	23	2358	17
8	19	1028	21	0053	17
9	19	2333	26	0658	16
10	23	0038	26	2353	21
11	18	0003	21	2353	16
12	15	0008	16	2348	13
13	12	0008	13	2038	11
14	55	1318	93	0003	12
15	96	1733	104	0653	88
16	100	0923	104	2353	93
17	80	0003	93	2358	68
18	60	0003	68	2358	54
19	47	0008	54	2353	40
20	37	0003	40	2358	33
21	29	0003	33	2343	26
22	25	1443	27	2348	24
23	30	2358	39	0128	23
24	44	1823	47	0003	39
25	43	0018	45	2358	39
26	34	0003	39	2358	31
27	26	0008	30	2358	23
28	21	0013	23	2358	19
29	17	0003	19	2353	15
30	14	0003	15	2358	13
31	11	0003	13	2358	10
TOTAL	1118		- - -		- - -
AVERAGE	36		42		31
MAXIMUM	100		104		93
MINIMUM	11		13		10
ACRE FT	2218		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

SEPTEMBER 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	10	0013	10	2353	8.7
2	8.2	0018	8.7	0813	7.7
3	7.3	1443	7.7	0728	6.5
4	6.9	1438	6.9	0728	6.5
5	7.3	1423	9.7	2358	5.7
6	5.4	1528	5.7	2338	5.0
7	4.7	0008	5.0	2243	4.4
8	5.0	1748	5.4	0253	4.4
9	5.0	1803	5.7	0848	4.4
10	4.7	1018	7.3	0813	2.4
11	4.4	0013	5.4	2358	3.4
12	4.7	1358	6.5	0128	3.2
13	5.4	0003	6.5	0758	4.7
14	4.4	1113	7.7	0733	2.4
15	5.0	1053	10	0558	3.2
16	4.2	2348	4.4	0818	3.9
17	76	2348	673	0003	4.4
18	532	0253	686	2353	424
19	318	0008	424	2348	243
20	200	0003	243	2348	168
21	213	2323	260	0028	168
22	298	0803	330	0008	257
23	226	0048	275	2358	188
24	141	0008	188	1933	104
25	- - -		- - -		- - -
26	- - -		- - -		- - -
27	- - -		- - -		- - -
28	- - -		- - -		- - -
29	- - -		- - -		- - -
30	- - -		- - -		- - -
TOTAL	2094		- - -		- - -
AVERAGE	87		133		68
MAXIMUM	532		686		424
MINIMUM	4.2		4.4		2.4
ACRE FT	4154		- - -		- - -


Akutoktak River
1991
Average Daily Discharge (cfs)
700
600
500
400
300
200
100
0
June 1
June 11
June 21
July 1
July 11
July 21
July 31
Aug 10
Aug 20
Aug 30
Sept 9
Sept 19
Gaging Dates (1991)

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

LOCATION.--Lat 69°50'19", long 144°24'43", NE¼NW¼NW¼ sec. 33, T.6N., R.31E., 0.6 miles upstream from the confluence with the Itkilyariak Creek, 20.75 miles south-southwest of Kaktovik, Alaska.

DRAINAGE AREA.--26.9 mi², of which 8.7 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990;June to Sept. 1991.

REMARKS.--This is a 3rd Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1,419 cfs Aug. 20, 1989 @ 1825 hrs; Minimum Discharge, 0 cfs July 2-6, 1989, and July 13-16, 1990.

JUNE 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -		- - -		- - -
2	- - -		- - -		- - -
3	- - -		- - -		- - -
4	- - -		- - -		- - -
5	- - -		- - -		- - -
6	- - -		- - -		- - -
7	155	1545	167	0635	122
8	111	0005	144	0835	100
9	90	0005	111	0730	80
10	70	0005	80	0655	61
11	61	2355	70	0515	52
12	70	2340	111	0945	61
13	178	2355	260	0005	100
14	241	1550	276	2245	19
15	170 e	0010	- - -	1345	- - -
16	120 e	0035	- - -	1105	- - -
17	100 e	2215	- - -	1310	- - -
18	178	1850	221	0810	144
19	144	0010	189	1225	111
20	144	1800	189	0940	100
21	122	2235	167	1315	90
22	100	0005	155	1510	70
23	70	2020	100	1115	52
24	52	0020	80	1515	37
25	37	2400	52	1405	30
26	80	1515	155	0625	37
27	70	0010	100	1300	61
28	52	0010	80	1150	44
29	44	1625	61	1140	30
30	37	0005	44	1510	37
TOTAL	2495		- - -		- - -
AVERAGE	104		134		68
MAXIMUM	241		276		144
MINIMUM	37		44		19
ACRE FT	4949		- - -		- - -

NOTE: e = Estimated

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

JULY 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	30	0015	37	1620	24
2	19	0010	24	1655	14
3	14	0025	19	1905	11
4	11	0205	14	2230	8.1
5	8.1	2355	11	1925	6.5
6	8.1	0230	14	1855	6.5
7	8.1	0040	11	1715	8.1
8	8.1	2400	8.1	2350	6.5
9	6.5	0330	6.5	2355	6.0
10	6.5	1710	8.1	0140	6.0
11	6.5	1425	6.5	2355	6.5
12	6.5	1345	8.1	0155	6.5
13	8.1	0645	8.1	2345	6.5
14	6.5	0010	6.5	2250	6.0
15	6.0	2355	6.5	2400	6.0
16	11	1105	19	2400	6.5
17	8.1	0005	11	2115	8.1
18	8.1	2105	14	1555	6.5
19	14	1310	14	2355	11
20	8.1	2400	11	2340	8.1
21	37	1945	178	0345	8.1
22	- - -		- - -		- - -
23	- - -		- - -		- - -
24	- - -		- - -		- - -
25	- - -		- - -		- - -
26	- - -		- - -		- - -
27	- - -		- - -		- - -
28	- - -		- - -		- - -
29	- - -		- - -		- - -
30	- - -		- - -		- - -
31	- - -		- - -		- - -
TOTAL	239		- - -		- - -
AVERAGE	11		21		8.4
MAXIMUM	37		178		24
MINIMUM	6.0		6.5		6.0
ACRE FT	475		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

AUGUST 1991

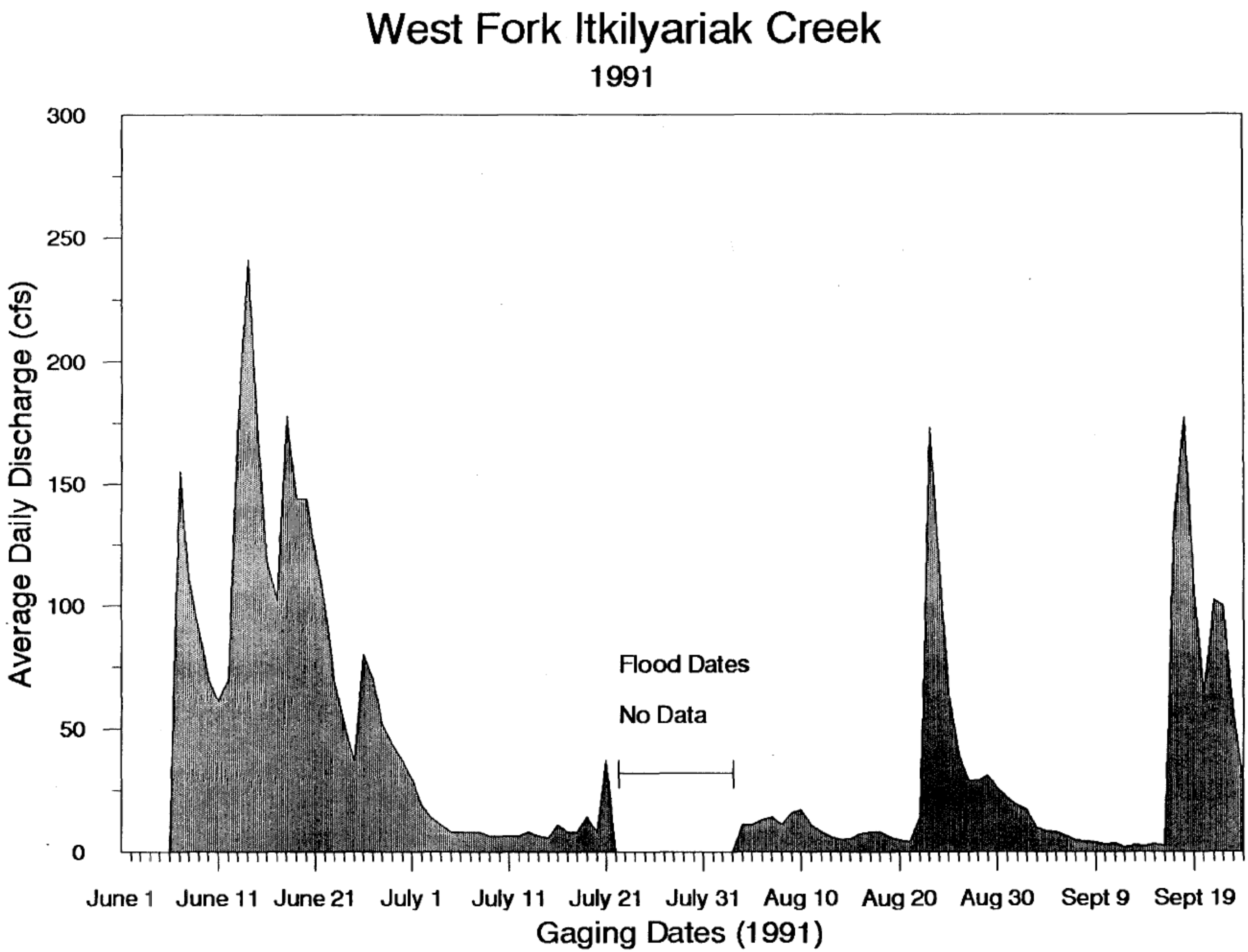
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -		- - -		- - -
2	- - -		- - -		- - -
3	- - -		- - -		- - -
4	11	0722	11	1917	11
5	11	0942	11	2242	9.5
6	13	2012	21	0007	10
7	14	0017	20	2342	12
8	11	2357	14	1432	11
9	16	2357	17	0007	14
10	17	0647	20	2357	13
11	11	0012	13	2347	9.5
12	7.9	0022	9.5	2342	7.0
13	6.1	0002	7.0	2342	5.6
14	5.2	0007	5.6	2327	4.8
15	5.6	2347	6.1	0037	4.8
16	7.4	1257	8.4	0012	6.1
17	7.9	0647	8.4	1707	7.9
18	7.9	0452	8.4	2352	7.0
19	6.1	0002	7.0	2357	5.6
20	4.8	0027	5.6	2357	4.4
21	4.1	0002	4.4	2352	3.4
22	14	2342	207	0627	3.1
23	173	0022	210	2337	154
24	115	0022	157	2342	86
25	64	0002	88	2357	49
26	40	0037	49	2352	32
27	29	0447	34	2332	26
28	29	0712	33	0017	26
29	31	0607	38	2212	26
30	26	0512	32	2307	21
31	22	0742	25	2317	18
TOTAL	710		- - -		- - -
AVERAGE	25		38		21
MAXIMUM	173		210		154
MINIMUM	4.1		4.4		3.1
ACRE FT	1408		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek, West Fork

SEPTEMBER 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	19	0507	20	1847	17
2	17	0402	21	2347	12
3	10	0002	12	2337	9.0
4	8.4	0007	9.0	2157	7.9
5	7.9	1537	9.0	2352	7.0
6	6.5	0007	7.4	2357	5.6
7	4.8	0007	5.6	2332	4.1
8	4.4	1722	4.8	0322	4.1
9	4.1	0002	4.4	1332	3.7
10	3.1	2257	5.2	1457	2.0
11	3.7	0122	4.8	1247	2.5
12	2.2	0002	3.1	1902	1.7
13	2.8	2242	3.7	1422	2.2
14	2.5	2332	4.4	0647	1.1
15	3.4	0037	4.4	1327	2.8
16	2.5	2352	3.4	1337	2.0
17	137	1937	226	0002	3.4
18	177	0007	207	2352	154
19	105	0007	154	2357	79
20	64	0007	81	1522	57
21	102	2137	129	0022	60
22	100	0012	127	2342	76
23	56	0012	78	2357	44
24	29	0017	44	1027	21
25	- - -		- - -		- - -
26	- - -		- - -		- - -
27	- - -		- - -		- - -
28	- - -		- - -		- - -
29	- - -		- - -		- - -
30	- - -		- - -		- - -
TOTAL	872		- - -		- - -
AVERAGE	36		49		24
MAXIMUM	177		226		154
MINIMUM	2.2		3.1		1.1
ACRE FT	1730		- - -		- - -


West Fork Itkilyariak Creek
1991
Average Daily Discharge (cfs)
300
250
200
150
100
50
0
Flood Dates
No Data
June 1
June 11
June 21
July 1
July 11
July 21
July 31
Aug 10
Aug 20
Aug 30
Sept 9
Sept 19
Gaging Dates (1991)

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

LOCATION.--Lat 70°0'35", Long 143°1'54", NW¼NW¼NE¼ sec. 36, T.8N., R.36E., 6 miles upstream from the mouth, 16.5 mi south-east of Kaktovik, Alaska.

DRAINAGE AREA.--136.2 mi².

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 2,071 cfs Aug. 21, 1989 @ 0310 hrs; Minimum Discharge, estimated 0 cfs Aug. 2, 7, 10-27, 1990.

JUNE 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -		- - -		- - -
2	- - -		- - -		- - -
3	- - -		- - -		- - -
4	- - -		- - -		- - -
5	- - -		- - -		- - -
6	- - -		- - -		- - -
7	- - -		- - -		- - -
8	- - -		- - -		- - -
9	- - -		- - -		- - -
10	- - -		- - -		- - -
11	- - -		- - -		- - -
12	- - -		- - -		- - -
13	1114	2359	1268	0004	1023
14	1281	1504	1319	1859	1241
15	1114	0044	1272	1824	977
16	888	0004	998	1839	813
17	781	2349	877	1459	691
18	946	2324	1074	0259	851
19	867	0004	1059	1314	755
20	765	2054	872	1214	659
21	654	0004	824	1454	571
22	525	0004	712	2144	422
23	352	0024	427	1654	304
24	308	0209	408	2349	250
25	215	0044	254	1554	189
26	246	2359	313	0004	204
27	326	2359	422	1244	291
28	361	0314	446	1559	313
29	339	2339	427	1224	287
30	308	0029	422	2334	242
TOTAL	11391		- - -		- - -
AVERAGE	633		744		560
MAXIMUM	1281		1319		1241
MINIMUM	215		254		189
ACRE FT	22593		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

JULY 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	200	0014	242	1619	182
2	175	0204	193	1554	161
3	148	0004	168	1834	132
4	117	0004	139	2359	95
5	82	0004	95	1024	77
6	100	2354	123	0009	87
7	117	0759	135	2344	95
8	77	0004	95	1404	72
9	67	0004	72	2359	63
10	54	0004	63	2359	46
11	43	0009	46	0854	39
12	41	2219	46	0854	36
13	48	2229	54	0539	45
14	59	2359	77	0744	52
15	87	2344	100	0009	77
16	106	2359	126	0124	97
17	109	0109	126	2249	92
18	87	0014	92	2354	82
19	79	2224	97	0944	72
20	95	0704	106	1619	90
21	120	2354	165	0229	95
22	193	2359	321	1454	165
23	515	1049	581	0004	321
24	366	0009	490	2354	308
25	219	0004	308	2359	165
26	132	0009	165	2349	114
27	103	0014	114	2359	92
28	77	0004	92	2359	70
29	65	0014	70	1404	61
30	63	0014	67	2359	59
31	56	2019	61	0859	52
TOTAL	3802		- - -		- - -
AVERAGE	123		149		103
MAXIMUM	515		581		321
MINIMUM	41		46		36
ACRE FT	7540		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

AUGUST 1991

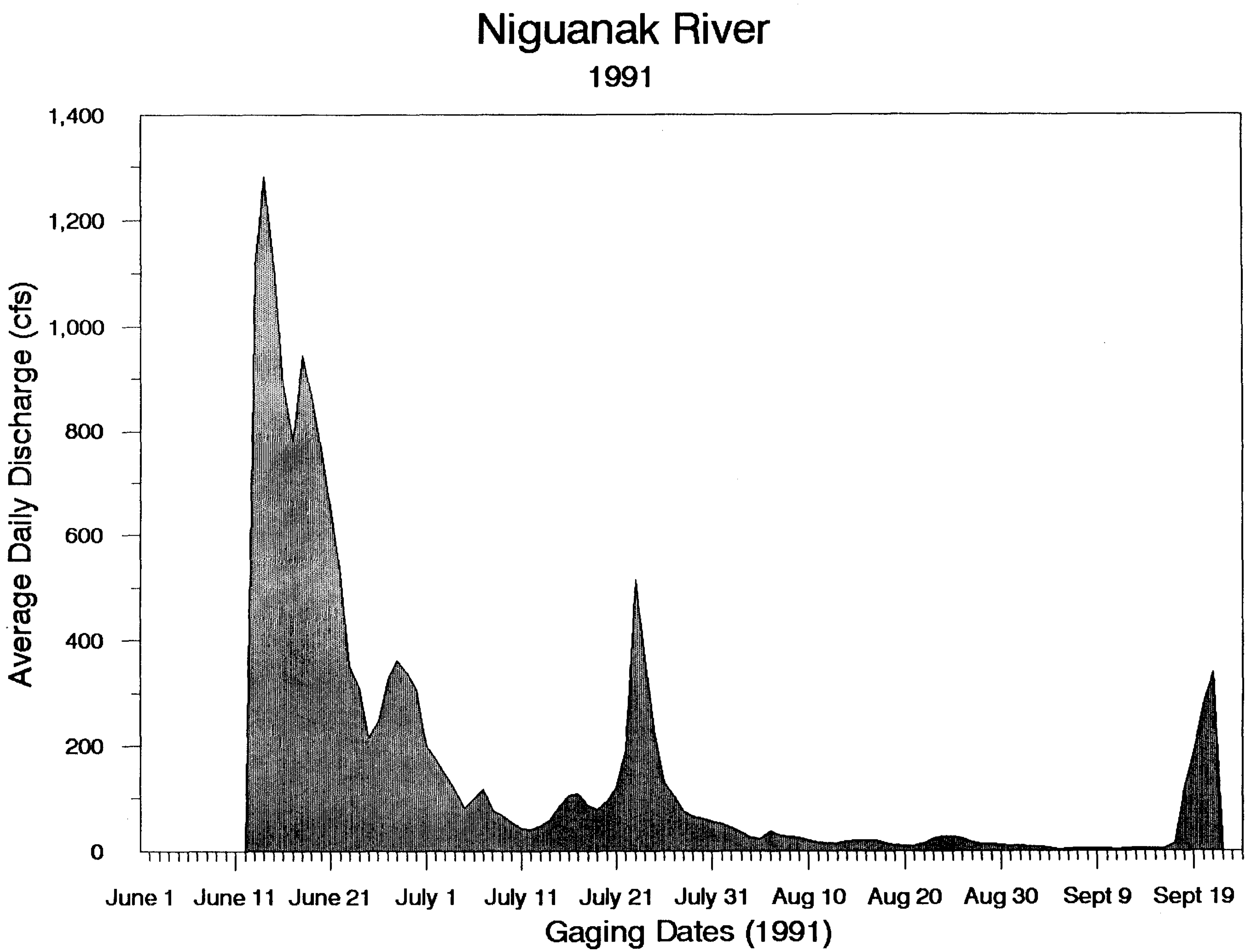
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	52	0004	59	1259	50
2	45	0004	50	1029	43
3	36	0004	45	2359	31
4	26	0004	31	2359	23
5	23	2304	43	0909	21
6	37	1744	48	0224	29
7	29	0004	37	0949	28
8	28	1534	36	0724	25
9	26	0824	31	1529	23
10	21	0004	23	1244	18
11	17	0009	21	2359	16
12	15	2344	16	1054	14
13	16	2359	20	1019	15
14	18	2359	21	1109	17
15	20	0159	25	1019	18
16	21	2014	23	0839	18
17	21	0019	23	0939	18
18	16	0004	20	2359	13
19	11	0004	13	0819	10
20	10	0029	11	2354	8.5
21	9.3	1244	11	0644	7.8
22	15	2354	21	0004	10
23	23	1349	31	0154	17
24	28	1959	31	0619	25
25	28	0004	29	0819	25
26	23	0004	26	2359	22
27	17	0004	22	0949	16
28	14	0004	16	0819	13
29	13	0004	15	0819	11
30	11	0004	12	2344	10
31	9.3	1609	10	0749	9.3
TOTAL	678		- - -		- - -
AVERAGE	22		26		20
MAXIMUM	52		59		50
MINIMUM	9.3		10		7.8
ACRE FT	1346		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Niguanak River

SEPTEMBER 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	9.3	0619	11	2309	8.5
2	8.5	1619	9.3	2354	7.8
3	7.8	1704	7.8	0454	7.1
4	6.4	0004	7.1	2329	2.8
5	3.4	2009	5.8	1044	2.1
6	3.8	1924	6.4	1014	2.1
7	5.2	1729	7.1	2359	3.4
8	3.8	1814	5.8	0324	2.6
9	5.2	1329	6.4	0704	4.2
10	3.8	0004	4.7	2014	3.4
11	3.4	2339	5.8	1144	2.1
12	4.7	0114	7.1	1304	3.4
13	4.7	1729	6.4	0934	3.1
14	3.8	0204	5.2	2349	2.8
15	3.8	1209	14	0919	2.1
16	4.7	2319	7.8	1044	2.4
17	16	2359	61	0014	7.1
18	117	2359	193	0004	63
19	196	2344	250	0849	165
20	283	2344	300	0029	246
21	339	2349	432	0024	300
22	- - -		- - -		- - -
23	- - -		- - -		- - -
24	- - -		- - -		- - -
25	- - -		- - -		- - -
26	- - -		- - -		- - -
27	- - -		- - -		- - -
28	- - -		- - -		- - -
29	- - -		- - -		- - -
30	- - -		- - -		- - -
TOTAL	1034		- - -		- - -
AVERAGE	49		64		40
MAXIMUM	339		432		300
MINIMUM	3.4		4.7		2.1
ACRE FT	2050		- - -		- - -



Niguanak River
1991
1,400
1,200
1,000
800
600
400
200
0
Average Daily Discharge (cfs)
June 1
June 11
June 21
July 1
July 11
July 21
July 31
Aug 10
Aug 20
Aug 30
Sept 9
Sept 19
Gaging Dates (1991)

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

LOCATION.--Lat 69°38', long 144° 22'50", in NW¼SW¼ sec. 31, T.4N., R.32E., 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

DRAINAGE AREA.--520.1 mi², of which 517.5 mi² is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi² depending on existing climatic conditions.

PERIOD OF RECORD.-- July to Sept. 1988; June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 21,000 cfs July 21, 1991; Minimum Discharge, 39 cfs Sept. 15, 1991 @ 1413 hrs.

JUNE 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -		- - -		- - -
2	- - -		- - -		- - -
3	- - -		- - -		- - -
4	1304	2358	2165	1543	977
5	1583	0138	2252	1658	1126
6	1291	0023	2013	1858	947
7	844	0133	1172	2343	641
8	543	0313	661	2348	475
9	430	0008	475	2343	397
10	371	0008	397	2358	365
11	374	0003	365	1803	389
12	389	0443	382	1743	398
13	365	2358	418	0003	385
14	792	2353	1149	0003	418
15	1028	0443	1267	1848	835
16	918	0513	1104	2103	759
17	768	2358	1329	1628	648
18	1932	2348	3371	0003	1329
19	2584	0013	3461	1353	1948
20	2921	2358	3906	1423	2342
21	3305	2333	4355	1423	2681
22	3621	0258	4537	1658	3131
23	3067	2233	4563	1223	2324
24	2880	0003	4458	1933	2131
25	2097	2258	2415	1628	1868
26	3715	1508	6137	0638	2288
27	3239	0018	4510	1653	2720
28	2527	0128	2942	1538	2200
29	2642	2238	3004	1438	2324
30	2880	1913	3461	0958	2508
TOTAL	48412		- - -		- - -
AVERAGE	1793		2454		1428
MAXIMUM	3715		6137		3131
MINIMUM	365		365		365
ACRE FT	96024		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

JULY 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	2324	0003	3067	2018	1916
2	1775	0203	2046	2038	1527
3	1432	0318	1641	2308	1242
4	1195	0543	1316	2333	1039
5	987	0558	1071	2358	871
6	909	2353	1050	1908	844
7	1050	0553	1172	2238	909
8	844	0013	957	2358	705
9	648	0013	705	2348	577
10	554	0028	583	2353	512
11	475	0013	517	2358	440
12	421	0013	440	2253	399
13	401	0758	406	1948	390
14	399	1818	412	0438	390
15	433	1308	455	0018	399
16	543	0853	634	0003	444
17	538	0708	572	0003	507
18	835	2358	1685	0003	527
19	1641	0618	2097	2358	1207
20	1060	0033	1230	2348	890
21	9200 e		21000 e	0523	853
22	- - -		- - -		- - -
23	- - -		- - -		- - -
24	- - -		- - -		- - -
25	- - -		- - -		- - -
26	- - -		- - -		- - -
27	- - -		- - -		- - -
28	- - -		- - -		- - -
29	- - -		- - -		- - -
30	- - -		- - -		- - -
31	- - -		- - -		- - -
TOTAL	24782		- - -		- - -
AVERAGE	1126		2038		852
MAXIMUM	9200 e		21000 e		2148
MINIMUM	399		406		390
ACRE FT	49154		- - -		- - -

NOTE: e = Estimate

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

AUGUST 1991

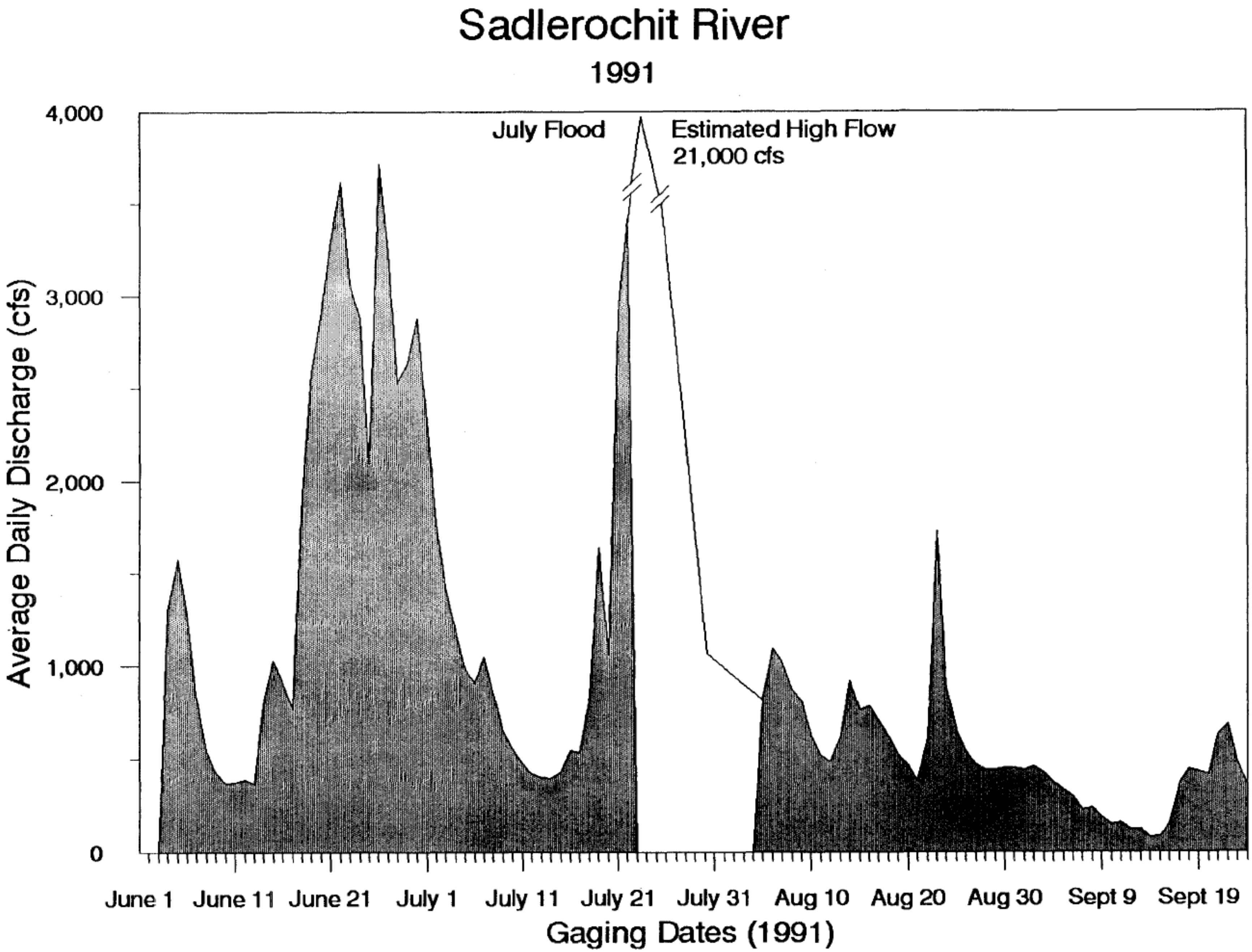
DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -		- - -		- - -
2	- - -		- - -		- - -
3	- - -		- - -		- - -
4	- - -		- - -		- - -
5	819	0123	895	2228	750
6	1092	1438	1583	0523	730
7	1020	0008	1263	2343	856
8	872	2023	994	0628	798
9	812	0033	985	2303	673
10	614	0028	685	2308	549
11	523	0043	559	2233	474
12	479	1803	503	1513	460
13	620	2208	1351	0208	465
14	919	0008	1263	2228	736
15	763	1348	819	0438	717
16	784	1008	819	2353	723
17	698	0038	743	2353	655
18	620	0018	667	2353	559
19	528	0008	565	2343	489
20	465	0003	493	2328	433
21	380	0038	406	2358	351
22	608	2333	3643	0748	339
23	1732	0048	3439	2348	1092
24	887	0013	1102	2353	763
25	655	0038	763	1808	592
26	538	0003	597	2223	493
27	470	0028	503	1853	437
28	442	0603	465	1938	419
29	442	0953	460	2148	424
30	451	1033	479	0058	428
31	451	1043	479	2328	428
TOTAL	18684		- - -		- - -
AVERAGE	692		982		586
MAXIMUM	1732		3643		1092
MINIMUM	380		406		339
ACRE FT	37059		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

SEPTEMBER 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	442	1018	470	2248	424
2	460	1038	493	2258	424
3	424	0923	456	2358	380
4	376	0713	397	2358	343
5	334	0643	347	2318	310
6	294	0143	318	2358	263
7	227	0003	263	1723	204
8	235	0338	270	2133	208
9	188	0013	208	1503	168
10	148	0128	188	1848	120
11	156	0508	196	2358	120
12	120	1758	152	0628	108
13	124	0008	136	2358	112
14	78	2348	120	1133	44
15	83	1758	128	1413	39
16	148	2333	267	0008	99
17	368	2348	465	0003	270
18	446	2353	470	1423	433
19	433	0208	474	1238	415
20	415	0358	446	1943	389
21	631	2348	777	0008	419
22	685	0118	777	2343	597
23	484	0008	608	1608	433
24	355	0018	451	1753	294
25	- - -		- - -		- - -
26	- - -		- - -		- - -
27	- - -		- - -		- - -
28	- - -		- - -		- - -
29	- - -		- - -		- - -
30	- - -		- - -		- - -
TOTAL	7657		- - -		- - -
AVERAGE	319		370		276
MAXIMUM	685		777		597
MINIMUM	78		120		39
ACRE FT	15187		- - -		- - -



Sadlerochit River
1991
4,000
3,000
2,000
1,000
0
Average Daily Discharge (cfs)
July Flood
Estimated High Flow
21,000 cfs
June 1
June 11
June 21
July 1
July 11
July 21
July 31
Aug 10
Aug 20
Aug 30
Sept 9
Sept 19
Gaging Dates (1991)

A-20

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

LOCATION.--Lat 69°54'43", Long 142°30'52", SE¼SE¼ sec. 36, T.7N., R.38E., at confluence with the West Fork Sikrelurak River, 31 mi south-east of Katktovik, Alaska.

DRAINAGE AREA.-74.7 mi².

PERIOD OF RECORD.--June to Sept. 1989; June to Sept. 1990; June to Sept. 1991.

REMARKS.--This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

EXTREMES FOR PERIOD OF RECORD.--Maximum Discharge, 1787 cfs June 4, 1991 @ 2015 hr.; Minimum Discharge, 0 cfs July 20, 1989, August 14-28, 1990, and Sept. 6-8, 1991.

JUNE 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	- - -		- - -		- - -
2	- - -		- - -		- - -
3	- - -		- - -		- - -
4	586	2015	1787	0915	285
5	888	0145	1181	2345	771
6	534	0010	799	2245	422
7	304	0030	441	1320	215
8	190	0130	246	1100	161
9	133	0105	167	2355	100
10	88	2400	100	1045	75
11	80	1800	86	0120	75
12	138	2255	343	0035	77
13	359	2315	486	0750	294
14	578	1805	683	0030	453
15	447	2400	586	1125	393
16	343	2400	410	0850	313
17	289	2400	343	1225	250
18	308	1915	381	0820	250
19	234	0005	304	1025	193
20	186	2400	234	0845	149
21	136	1930	177	0935	106
22	92	2400	149	2355	73
23	68	1840	84	0925	57
24	55	0005	70	2355	49
25	44	2115	49	1135	39
26	51	2215	67	0715	38
27	68	1845	86	0820	59
28	61	0005	72	0940	52
29	58	1735	75	0745	46
30	44	0005	55	2350	40
TOTAL	6362		- - -		- - -
AVERAGE	236		350		187
MAXIMUM	888		1787		771
MINIMUM	44		49		38
ACRE FT	12618		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

JULY 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	38	0005	40	1005	35
2	36	1805	42	0920	31
3	31	1955	36	1005	27
4	25	0005	32	1505	23
5	24	2010	29	0945	20
6	26	1925	34	0850	20
7	22	2400	29	2345	20
8	18	2120	21	1140	16
9	16	0010	20	1110	14
10	14	2400	16	2355	13
11	13	2125	16	1050	10
12	13	2010	16	0940	11
13	14	2120	18	1000	11
14	16	2140	23	0950	11
15	17	1750	21	0830	13
16	18	1855	27	0810	13
17	15	2400	21	1030	12
18	14	1750	17	0810	11
19	14	1930	21	0920	10
20	14	2120	20	0845	10
21	39	2030	52	0535	31
22	47	2350	86	1315	38
23	118	1430	136	0005	88
24	98	0015	116	2355	84
25	70	2400	86	2345	62
26	55	2400	62	2340	51
27	46	0010	51	2355	44
28	40	0005	44	1050	38
29	36	2135	39	1000	34
30	33	0005	37	1335	31
31	31	0010	32	0835	29
TOTAL	1012		- - -		- - -
AVERAGE	33		40		28
MAXIMUM	118		136		88
MINIMUM	13		16		9.5
ACRE FT	2008		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

Sikrelurak River

AUGUST 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	28	2400	31	1155	26
2	25	0010	29	1210	23
3	18	2400	26	1355	15
4	14	2400	16	1615	13
5	14	2040	18	0955	12
6	16	0035	19	1240	13
7	13	0015	17	1340	11
8	12	1950	14	0955	10
9	11	0010	13	1325	8.9
10	8.9	2400	11	1450	8.4
11	8.4	0110	10	1840	7.3
12	7.8	2355	10	1235	7.3
13	10	0235	10	1505	8.4
14	8.9	2350	11	1300	7.3
15	8.9	0120	11	1120	7.8
16	10	2325	12	1110	8.4
17	8.9	0010	12	1830	7.8
18	6.2	0010	8.9	2320	5.1
19	4.6	2400	5.1	0750	4.1
20	4.6	0455	5.1	2345	4.1
21	4.6	2355	6.2	0825	4.1
22	8.9	2030	12	1020	6.2
23	11	2305	13	0605	8.9
24	14	2335	15	0010	13
25	15	1630	16	0500	15
26	14	0035	15	2345	13
27	11	2400	13	2355	10
28	10	2400	10	0955	1.0
29	7.8	2400	8.9	2245	7.3
30	6.7	0005	7.3	2240	5.7
31	5.7	0205	6.2	2310	5.1
TOTAL	344		- - -		- - -
AVERAGE	11		13		10
MAXIMUM	28		31		26
MINIMUM	4.6		5.1		1.0
ACRE FT	683		- - -		- - -

ARCTIC NATIONAL WILDLIFE REFUGE

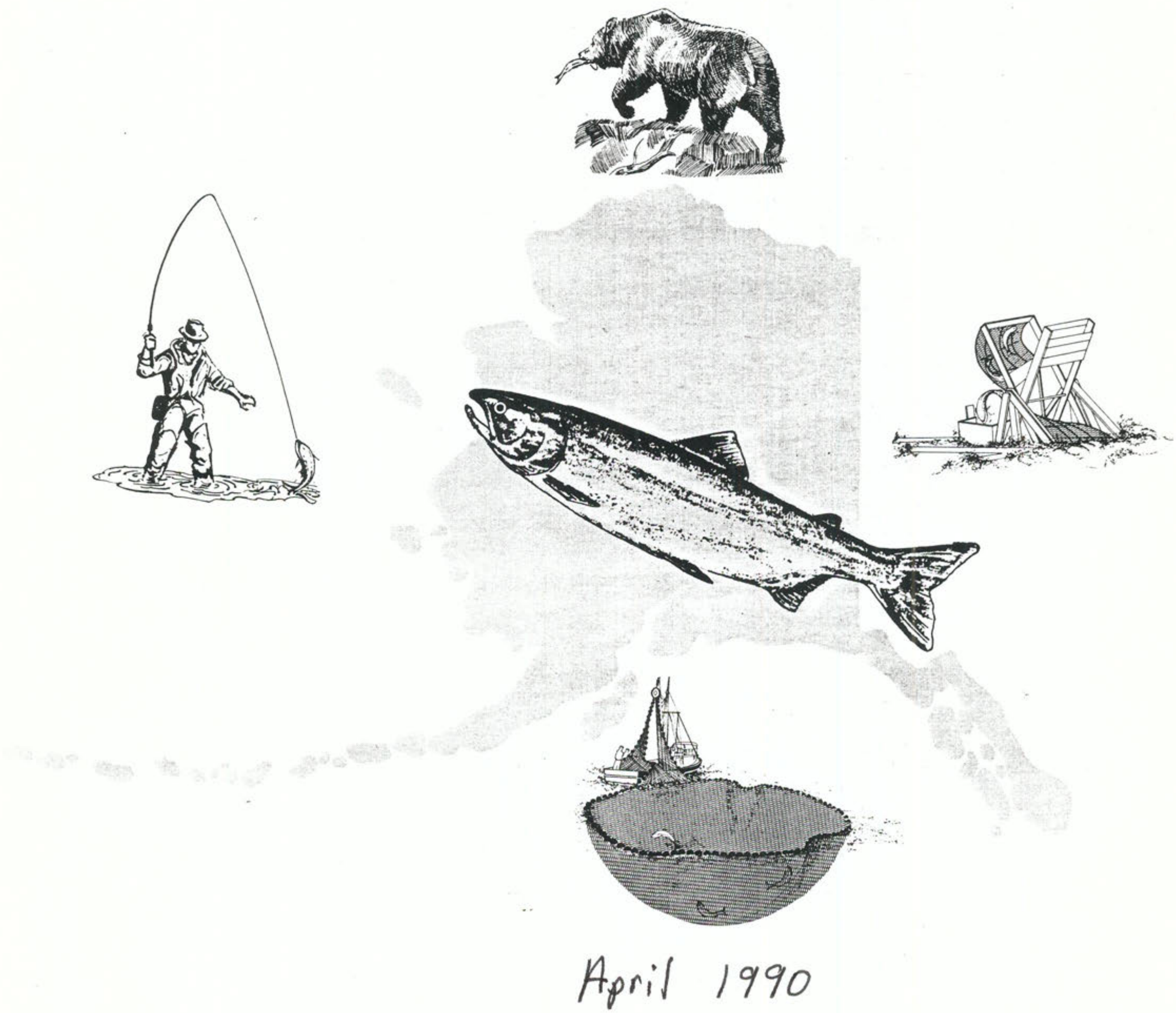
Sikrelurak River

SEPTEMBER 1991

DATE	AVE.DAILY DISCH. CU.FT/SEC	TIME OF MAX DISCH.	MAX DISCH. CU FT/SEC	TIME OF MIN DISCH.	MIN DISCH. CU. FT/SEC
1	5.1	0400	5.7	1715	4.6
2	4.1	0240	5.1	2355	3.1
3	3.6	1305	4.1	2330	3.1
4	3.1	1440	3.6	2340	2.5
5	3.6	0910	5.1	2350	1.5
6	3.1	1400	8.9	0430	0.0
7	2.0	1050	4.1	0835	0.0
8	2.5	1610	5.7	0050	0.0
9	4.1	1645	5.1	0525	1.5
10	3.6	2235	6.2	0450	1.0
11	6.2	0940	13	0325	2.0
12	4.1	1750	7.3	0400	1.0
13	5.1	2355	6.7	0705	3.1
14	6.2	0225	7.3	2355	3.6
15	8.9	0955	17	0030	3.1
16	7.8	0700	18	0250	3.1
17	11	2355	24	0745	7.3
18	40	2355	72	2400	24
19	80	2350	118	0750	61
20	133	0820	141	2400	116
21	146	2255	186	0905	128
22	158	0235	190	2345	138
23	111	2400	141	0915	84
24	79	2400	104	1000	54
25	- - -		- - -		- - -
26	- - -		- - -		- - -
27	- - -		- - -		- - -
28	- - -		- - -		- - -
29	- - -		- - -		- - -
30	- - -		- - -		- - -
TOTAL	832		- - -		- - -
AVERAGE	35		46		27
MAXIMUM	158		190		138
MINIMUM	2.0		3.6		0.0
ACRE FT	1649		- - -		- - -

Alaska Fisheries Technical Report Number 6

QUANTIFICATION AND DISTRIBUTION OF WINTER WATER WITHIN RIVER SYSTEMS OF THE 1002 AREA, ARCTIC NATIONAL WILDLIFE REFUGE



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QUANTIFICATION AND DISTRIBUTION OF WINTER WATER WITHIN RIVER SYSTEMS OF THE 1002 AREA, ARCTIC NATIONAL WILDLIFE REFUGE

GEORGE V. ELLIOTT
STEVEN M. LYONS

Water Resources Branch
Fisheries Management Services
U.S. Fish and Wildlife Service
1011 East Tudor Road
Anchorage, Alaska 99503

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Abstract

An inventory of the distribution and quantity of winter water in rivers was conducted within the 1002 area of the Arctic National Wildlife Refuge as part of an effort to develop a hydrologic data base, map sources of winter water, and determine water availability for oil and gas activities.

During April 10 through 19, 1989, locations of ice hummocks on all major river drainages in the area were identified using a LORAN navigation instrument. A subsample of nine hummocks was drilled to delineate water pool volumes. A positive linear relationship between hummock size and pool volume was developed and used to estimate the total volume of water available beneath all hummocks inventoried.

Although winter water was found to occur over a widespread area in most of the major river drainages in the 1002 area, the quantities were not great. Nearly 9 million gallons of water were estimated to be available along the 237 miles of river channel inventoried. It takes approximately 1,350,000 gal of water to construct and maintain each mile of ice road used to support oil exploration activities and 30,000 gal of water per day to support an oil exploration drill.

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Introduction

The location and quantity of water available in the frozen river systems during the winter months in the 1002 area of the Arctic National Wildlife Refuge (Figure 1) was studied to determine potential sources of water for oil exploration and development activities, such as ice roads, drill pads, and runways. Proposed oil and gas exploration and development may require significant quantities of water for these activities. Information on the spatial and temporal distribution of potential water sources is required to make informed decisions concerning the management of potential development so as to best protect aquatic habitats and the fish and wildlife resources that use them.

Water availability in the winter is strongly influenced by the climate which is characterized by extremely low winter temperatures and short, cool summers. Total annual precipitation averages 6.2 inches on Barter Island (Arctic Environmental Information and Data Center 1986). Ninety-nine percent of the 1002 area is classified as wetlands; however, water is limited and confined to the shallow zone above permafrost (Clough et al. 1987).

The major river drainages transecting the 1002 area are defined as mountain streams by Craig and McCart (1975). Perennial springs provide the only source of winter flow for mountain streams. Arcone et al. (1989) reported that ice cover along rivers throughout the 1002 area during winter months was generally frozen to the river beds, except for open reaches within aufeis areas that develop downstream from warm springs and beneath ice mounds found along the river channels (Figure 2). There is mention of ice structures similar to ice mounds in Alekseyev (1969) that are variously termed ice hummocks, naled hummocks, and heaving hummocks. Hummocks were reported in association with naleds or aufeisen (icings formed by extrusion of river or spring water), along stream courses, and beneath peat or vegetated soil cover (Alekseyev 1969, Are 1969, Bogomolov and Sklyarevskaya 1969, Bondarev and Gorbunov 1969, Bukayev 1969, Nekrasov 1969). The hummocks were reported forming over pressurized pools of water and in one case the pool beneath an ice hummock was determined to be hydraulically isolated (Are 1969). Nekrasov (1969) described several hummocks that were frozen to the substrate by late March and contained layers of substrate material within the ice.

Data gaps identified by Elliott (1989) provided the basis for investigations to determine availability of winter water in the 1002 area. The objectives of this study are to quantify the water volumes of pools beneath ice hummocks of frozen streams and rivers and the distribution of hummocks within the major 1002 drainages.

Methods

An inventory of ice hummocks within the rivers of the 1002 area was conducted April 10-19, 1989, at the approximate time of maximum ice development. A subsample of nine hummocks was measured for length, height, and water depth. Total length of each axis (length and width axis) was measured to the nearest foot using a fiberglass measuring tape. Maximum

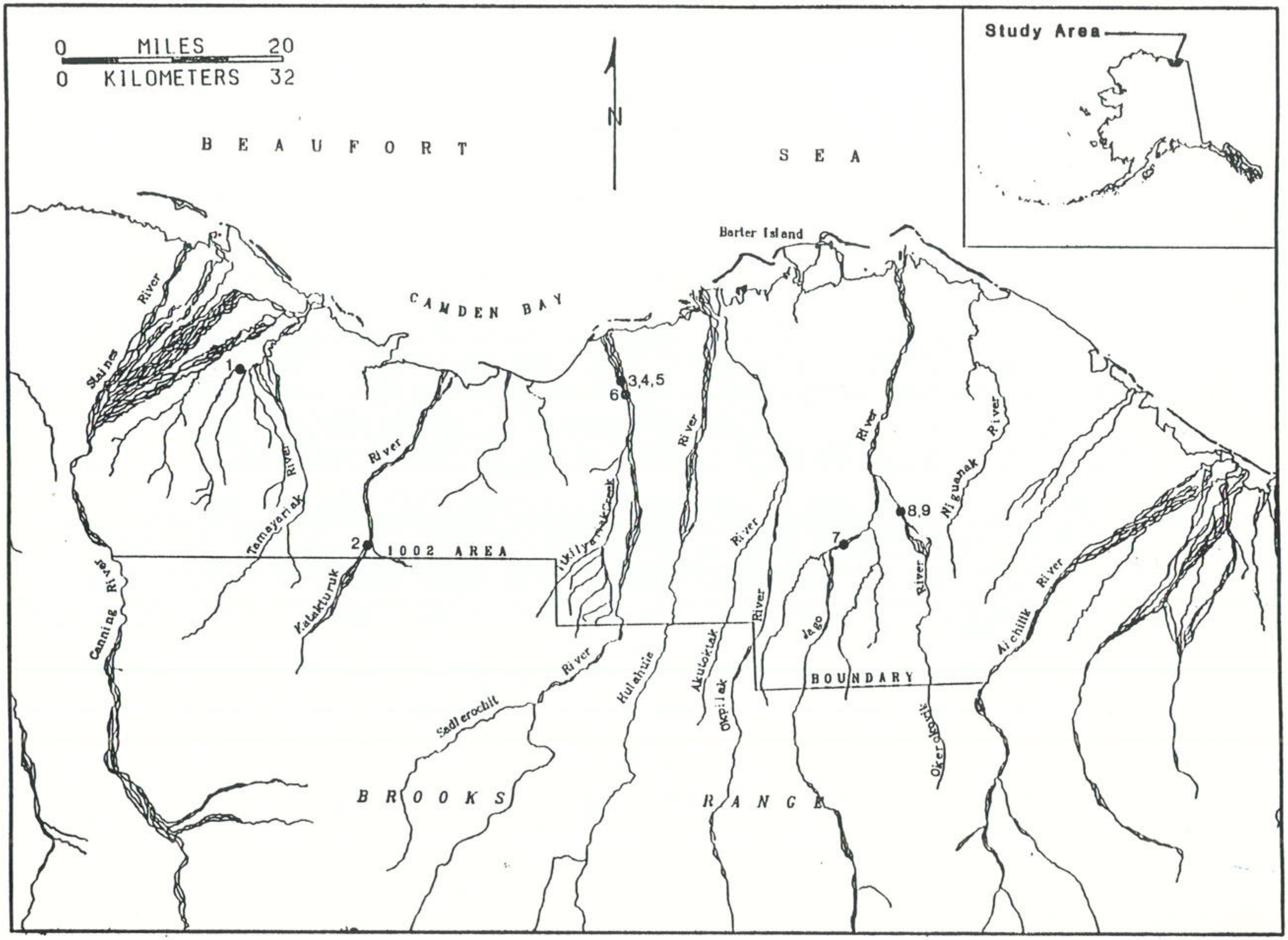

FIGURE 1.--The 1002 area, Arctic National Wildlife Refuge, Alaska, with locations of selected ice hummocks which were drilled for water and pool volume measurements.

FIGURE 2.--Ice hummocks on the lower Sadlerochit River, March, 1988.

height of hummocks was measured to the nearest 0.1 ft using a hand held level laid on the highest point of the hummock. Height was then read from a surveyors leveling rod which was held on the level surface of adjacent river ice or exposed substrate.

Using a steam drill, a series of vertical holes were drilled in each hummock to develop a profile of the water pool. The drill used a 3 gal, propane fired boiler to produce steam that was released through a one inch outside diameter hose, attached to a 6 ft rigid fiberglass drill stem fitted with a pointed one inch brass tip drilled with seven 1/16 inch diameter holes. Holes in excess of one inch diameter were drilled through clear ice at rates exceeding 3 ft/min.

Holes were drilled along a hummock's long axis until water pool margins were determined. Additional holes were drilled along three perpendicular lines crossing the long axis at 25, 50, and 75 percent of the total length. Holes along these three lateral axes were drilled until the water pool margin was located on either side of the length axis. Depth from the ice surface to the bottom of the pool was measured to the nearest 0.1 ft using a fiberglass measuring tape with a 4 inch steel rod attached to the end. The rod was attached to the end of the tape at its midpoint so that it would catch the bottom of the ice when retrieved by the tape, measuring vertical ice thickness. Water depth was obtained by subtracting vertical ice thickness from the ice surface to pool bottom depth. A wire attached to one end of the rod was used to retrieve the rod and tape from the hole.

When possible, dissolved oxygen and electrical conductivity of water beneath the ice hummocks were measured using electronic meters.

A contour map of each pool was developed from water depth data. The area of each strata was measured using a planimeter. The total volume of the pool was then calculated using the following formula (Welch 1948):

$$V = \sum[h/3\ (a_1 + a_2 + \sqrt{a_1 a_2})]/0.1337\ \text{ft}^3/\text{gal}$$

where, V = volume (gal)
h = strata height (ft)
a_1 = area of top of strata (ft^2)
a_2 = area of bottom of strata (ft^2)

Linear, curve, and polynomial regression equations for pool volume versus three hummock size parameters (length, maximum height, and size coefficient) were determined. The dimensionless size coefficient is defined as the product of length and maximum height.

The regression equation with the highest correlation was used to estimate the water volume beneath all ice hummocks. Total water volume for each drainage was obtained by summing the pool volume estimates of each hummock in the drainage.

An inventory of the distribution and size of ice hummocks, excluding those within aufeis fields, was made using a helicopter. The number of river miles

inventoried in each drainage were measured to the nearest 1.0 mi from 1:63,360 scale topographic maps using a map wheel. Flying along each river drainage, the locations of hummocks were determined with LORAN navigation equipment in the helicopter. The height and length of each ice hummock was visually estimated from the helicopter. Periodic stops were made to measure hummock height and length to ground truth visual estimations.

Ice hummock locations were plotted on 1:63,360 scale topographic maps from latitude and longitude coordinates recorded from the LORAN navigation unit. Location corrections were made by aligning an overlay map, registered to LORAN locations of known landmark locations, and by placing all locations within active floodplain boundaries.

Results

Water was found beneath seven of the nine ice hummocks drilled for pool volume estimation. The remaining two hummocks were frozen to the substrate. As few as 15 holes were drilled in the smallest hummock to as many as 35 holes in the larger hummocks. Hummock length and maximum height measurements ranged from 50 to 230 ft and from 3.0 to 10.6 ft, respectively (Table 1). Maximum measured water depths of the seven pools ranged from 0.3 to 5.8 ft.

Dissolved oxygen concentrations, measured in three of the seven pools, ranged from 0.2 to over 10.0 mg/l (Table 2). In addition to these three measurements, a dissolved oxygen concentration of 9.5 mg/l was measured beneath one ice hummock in the Sadlerochit River. Dissolved oxygen was not measured at all hummocks drilled because excessively cold and windy conditions reduced meter battery function to the point that meter response appeared to be questionable. Electrical conductivity could only be measured when the water beneath a hummock was under enough pressure to flow freely from the drill hole. Because of this constraint, conductivity was measured at only two of the seven pools located under the hummocks (Table 2).

Positive linear correlations were found between water pool volume and ice hummock height, length, and size coefficient. Hummock size coefficient was more strongly correlated with water volume ($r^2 = 0.77$) than either hummock length ($r^2 = 0.61$) or maximum height ($r^2 = 0.46$). The linear regression equation between pool volume and size coefficient provided the best fit to the data (Figure 3). The regression equation (Figure 3) relating volume in gallons (V) to size coefficient (C) was:

$$V = 38.16C - 8679.66$$

Visual estimates of maximum height and length were made for 604 ice hummocks found along the seven major river drainage systems in the 1002 area. Pool volume was estimated for each hummock using the linear regression equation of hummock size coefficient verses pool volume. The size parameter data and volume estimates for each hummock are presented in Appendix A. Based on 237 miles of river inventoried, a total of 8,839,200 gallons of water was estimated to occur beneath hummocks (Table 3). Based on an average requirement of 1,350,000 gal/mi/yr of ice road, the total water available in

TABLE 1.--Size parameters and calculated water volume of nine ice hummocks selected for study.

Drainage	Hummock Number	Maximum Height (ft)	Length (ft)	Size Coefficient	Water Volume (gal)
Tamayariak River	1	6.5	90	585	22,180
Katakturuk River	2	8.0	86	688	18,770
Sadlerochit River	3	10.6	75	795	35,690
Sadlerochit River	4	9.0	165	1,485	26,390
Sadlerochit River	5	7.8	230	1,794	72,440
Sadlerochit River	6	3.0	50	150	140
Jago River	7	5.1	60	306	170
Okerokovik River	8	3.4	95	323	0
Okerokovik River	9	4.8	110	528	0

TABLE 2.--Total dissolved oxygen and electrical conductivity measurements taken at selected ice hummocks and observation notes.

Drainage	Hummock Number	Dissolved Oxygen (mg/l)	Electrical Conductivity (umhos/cm)	Observation Notes
Tamayariak River	1	0.2	--	SO_2 odor.
Katakturuk River	2	> 10.0	--	Willow shrubs exposed at surface with water pool below.
Sadlerochit River	3	--	--	Gravel in ice @2.5 ft.
Sadlerochit River	4	8.5	690	Mud & gravel layer within ice @2 ft.
Sadlerochit River	5	--	--	Mud & gravel layer within ice @2 ft.
Sadlerochit River	6	--	--	Air space above water.
Jago River	7	--	12,000	Salty odor & extreme high pressure.
Okerokovik River	8	--	--	Dry, frozen to substrate. Rocks in ice.
Okerokovik River	9	--	--	Dry, frozen to substrate.

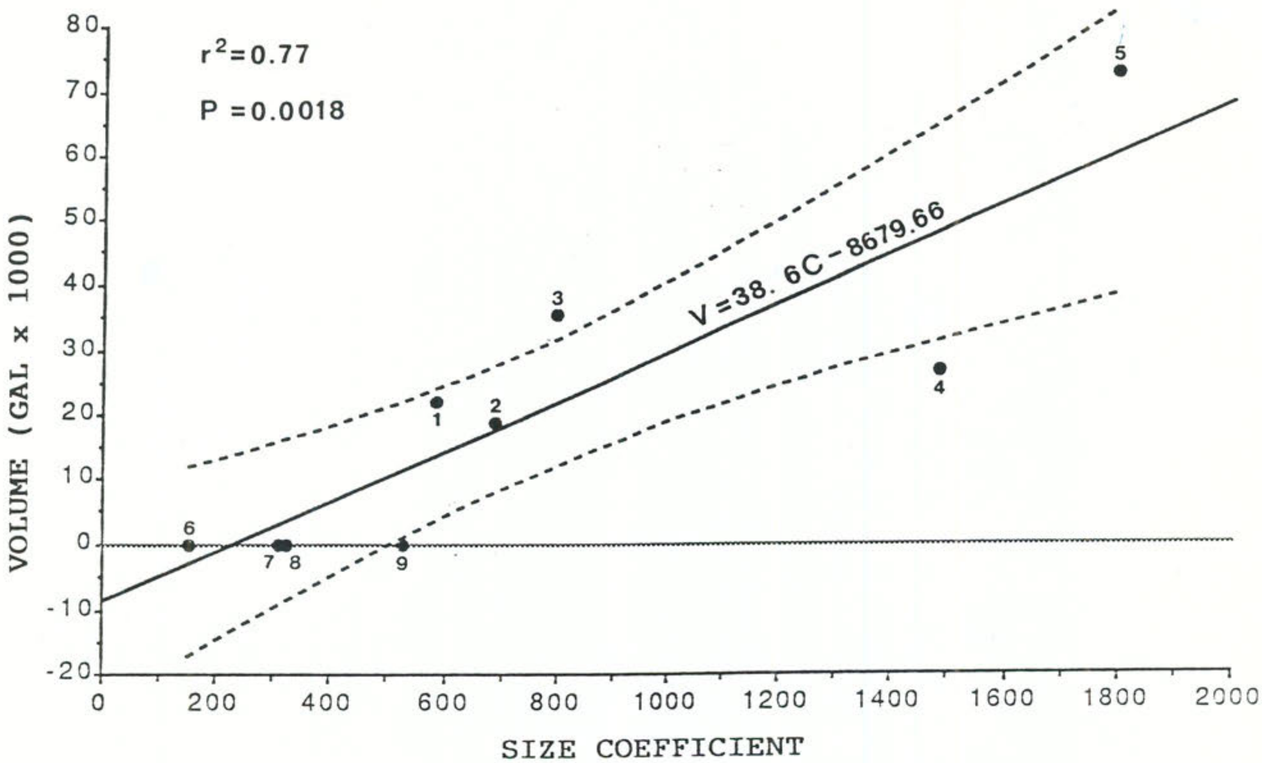

FIGURE 3.--Regression of ice hummock size coefficient versus water volume with the 95% confidence bounds for the true mean of Y. Data point numbers refer to hummock numbers on Table 1.

TABLE 3.--Data summary of ice hummock inventory by drainage system.

Drainage	Miles of River Surveyed	Ice Hummocks Observed (N)	Estimated Volume (gal)	Potential Miles of Ice Road
Canning River	35	138	1,861,000	1.4
Tamayariak River	34	45	438,100	0.3
Katakturuk River	23	60	829,200	0.6
Sadlerochit River	20	121	3,237,300	2.4
Hulahula River	25	165	2,100,600	1.6
Okpilak River	31	10	25,600	0.0
Jago River	69	65	447,400	0.3
TOTAL	237	604	8,939,200	6.6

the 237 river miles inventoried could support construction and maintenance of 6.6 mi of ice road.

Ice hummocks were widely distributed throughout the braided portions of the Canning, Tamayariak, Katakturuk, Sadlerochit, Hulahula, Okpilak, and Jago Rivers (Figures 4-9). The Niguanak and Angun Rivers were inspected for hummocks from their mouths upstream for 30 and 20 mi, respectively. No hummocks were observed on either river.

Discussion

Although winter water was found to occur over a widespread area in most of the major river drainages in the 1002 area, it was restricted to small isolated pools beneath ice hummocks scattered throughout the braided portions of these rivers. Are (1969) described the pool of water beneath a single ice hummock as hydraulically isolated. When the top of the hummock was cut into, the pressurized water contained beneath the ice rose into the excavated hole then stopped and froze over, indicating that the pool was not connected to a larger aquifer. The pools beneath some of the hummocks investigated during this study exhibited a similar response. Water was forced out of the initial drill hole but flow ceased after several minutes. One hummock was redrilled several days after the initial pool measurements were taken and there was no indication that any water pressure had built up over that time. It is unlikely that these isolated pools would become recharged if water were removed by any user.

Arcone et al. (1989) estimated pool volume beneath one ice hummock on the Sadlerochit River at 26,400 to 52,800 gal based on data collected with a helicopter mounted short impulse radar and a single measurement of water pool depth. Using their height and length measurements in the regression equation developed in this report, a pool volume estimate of 33,300 gal is obtained. The close agreement of these two estimates using two different methodologies during different years supports the transportability of the pool volume to size coefficient relationship to data collected in years other than 1989.

Knowledge of volume of water contained in pools beneath ice hummocks is critical in considering the area's potential for future large scale oil and gas exploration activities. Average water demands reported in the Prudhoe Bay area for oil and gas exploration are (Wilson et al. 1977; Clough et al. 1987);

Geophysical exploration	1,000 gpd/crew
Exploratory drilling	30,000 gpd/crew
Base camp (65 gpd/man x 75 men)...............	5,000 gpd/camp
Ice road construction and maintenance.........	1,350,000 gal/mi
Ice airstrip construction and maintenance.....	7,000,000 gal

where, gpd = gal per day

Within the 1002 area, 604 ice hummocks were found along a total of 237 miles of river channels. If the estimated 8.9 million gal of water found beneath the hummocks were used to construct ice roads for oil and gas exploration, a total of 6.6 mi of ice road could be constructed and

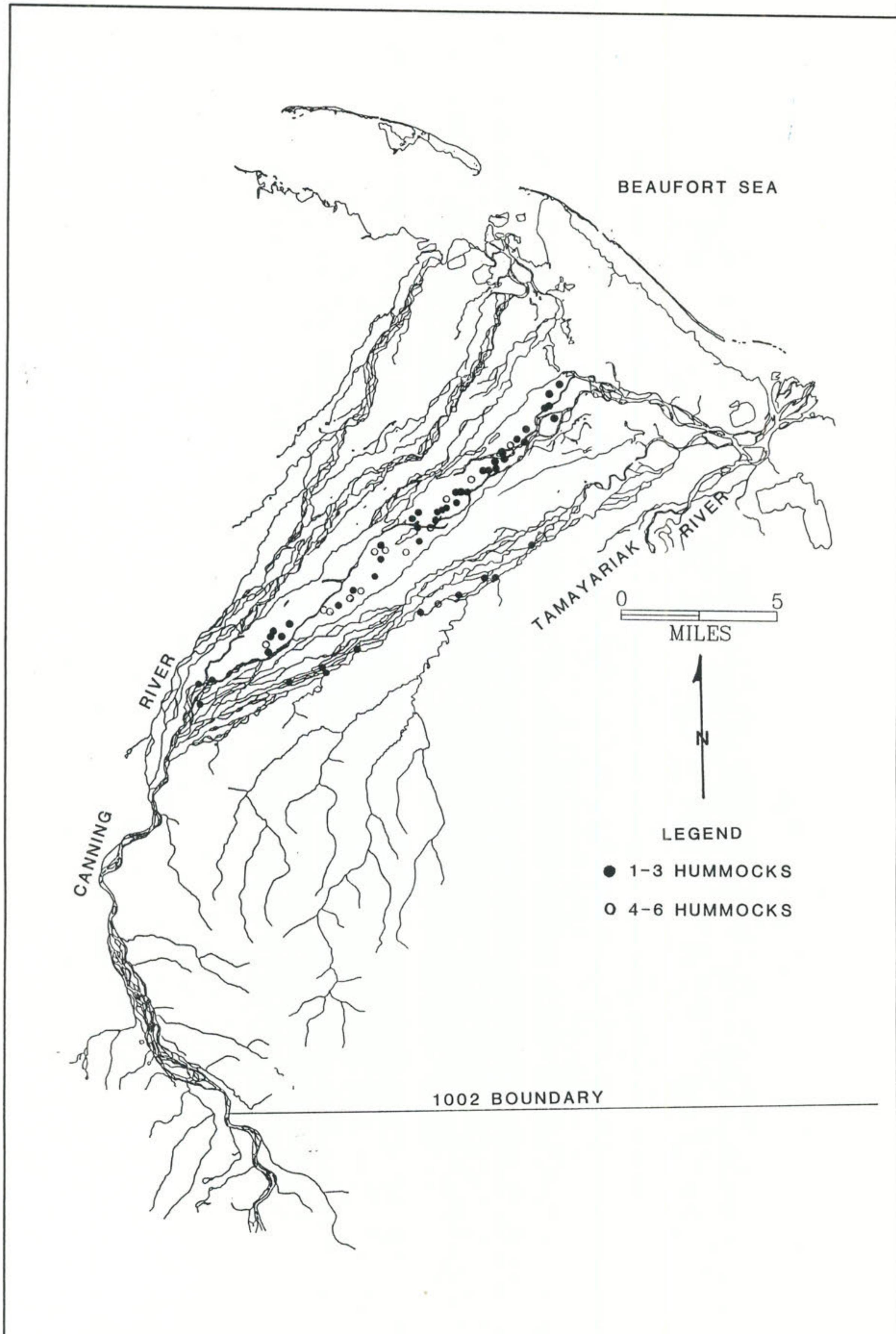

Figure 4.--Ice hummock locations in the Canning River drainage within the 1002 area, Arctic National Wildlife Refuge.

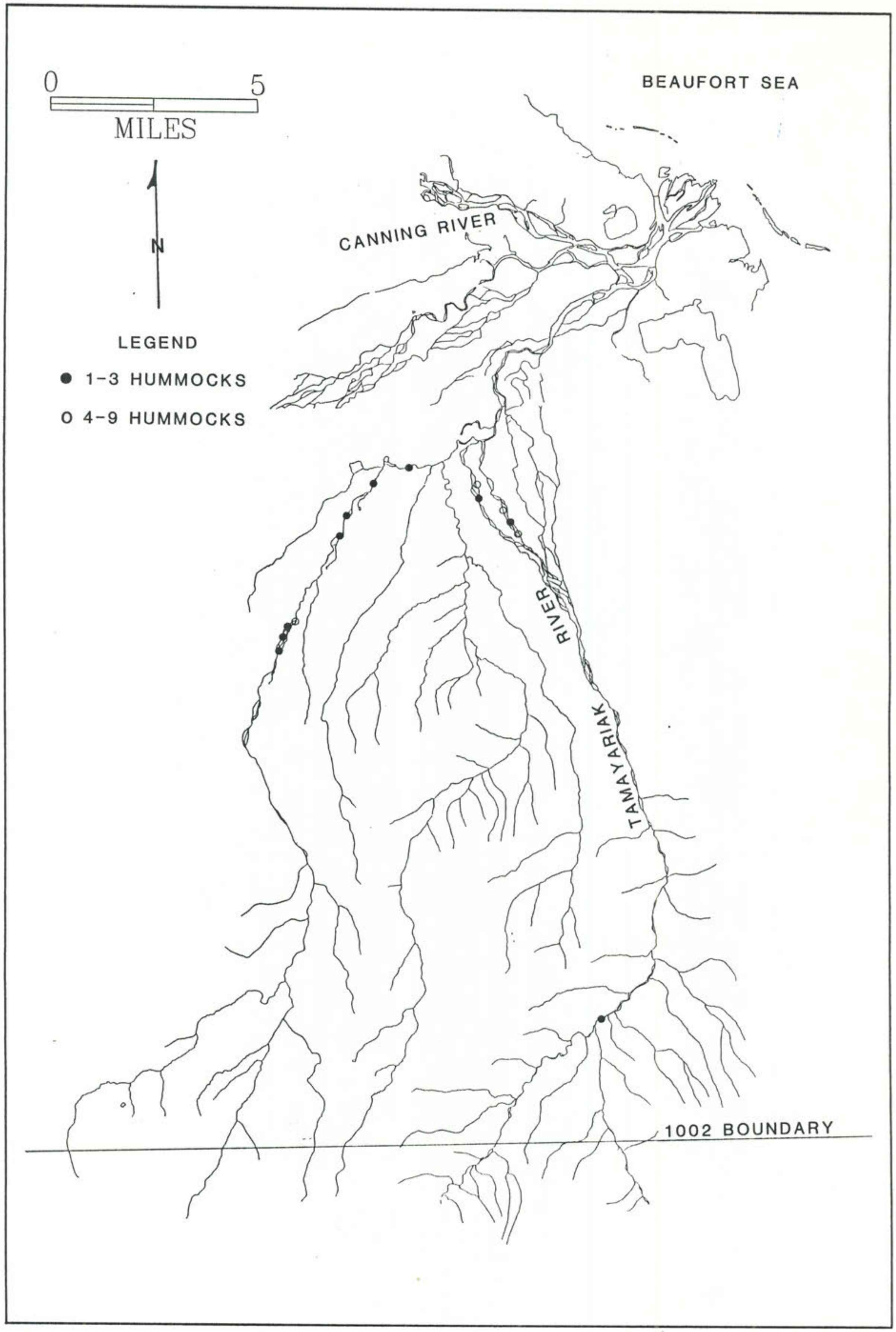

Figure 5.--Ice hummock locations in the Tamayariak River drainage within the 1002 area, Arctic National Wildlife Refuge.

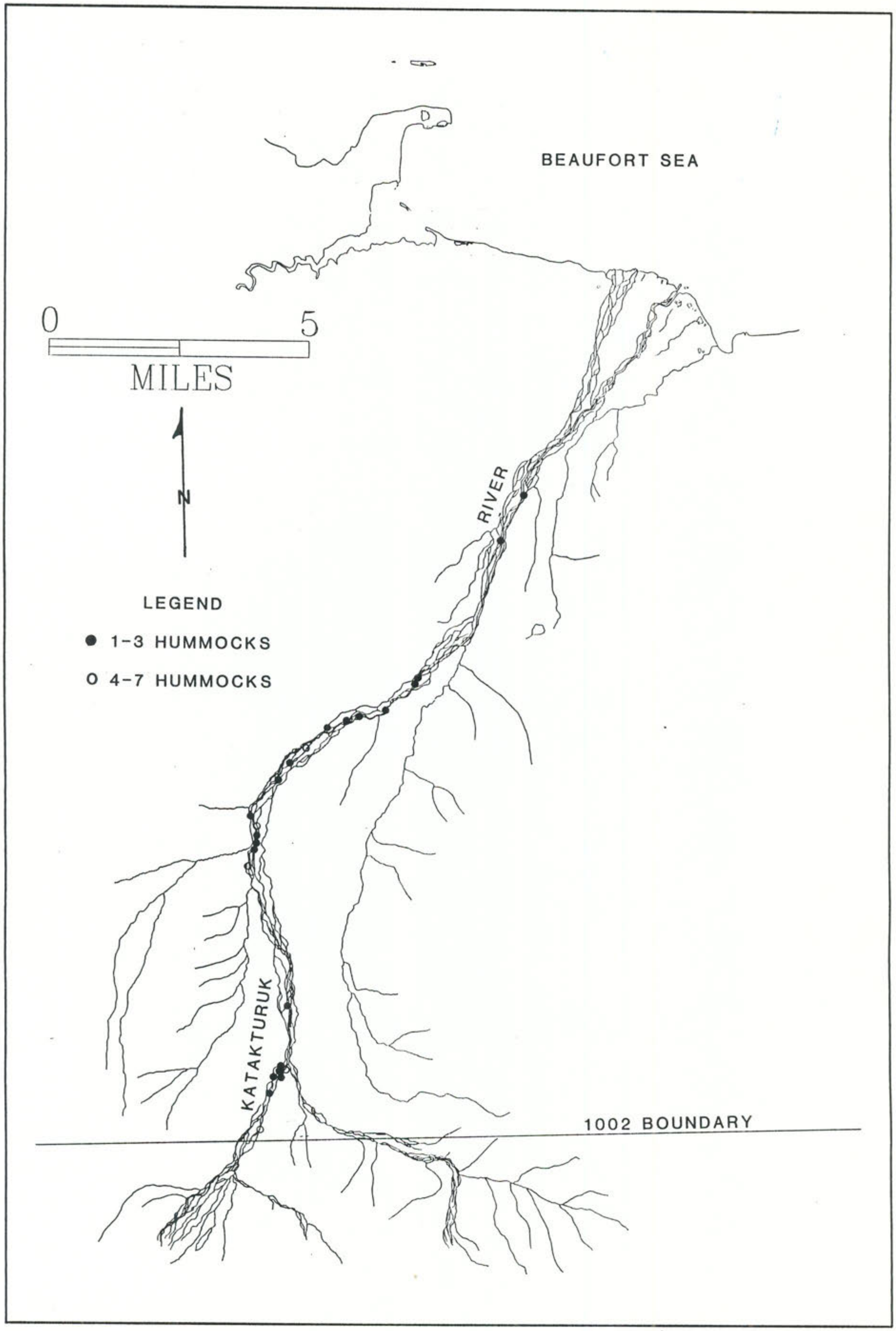

Figure 6.--Ice hummock locations in the Katakturuk River drainage within the 1002 area, Arctic National Wildlife Refuge.

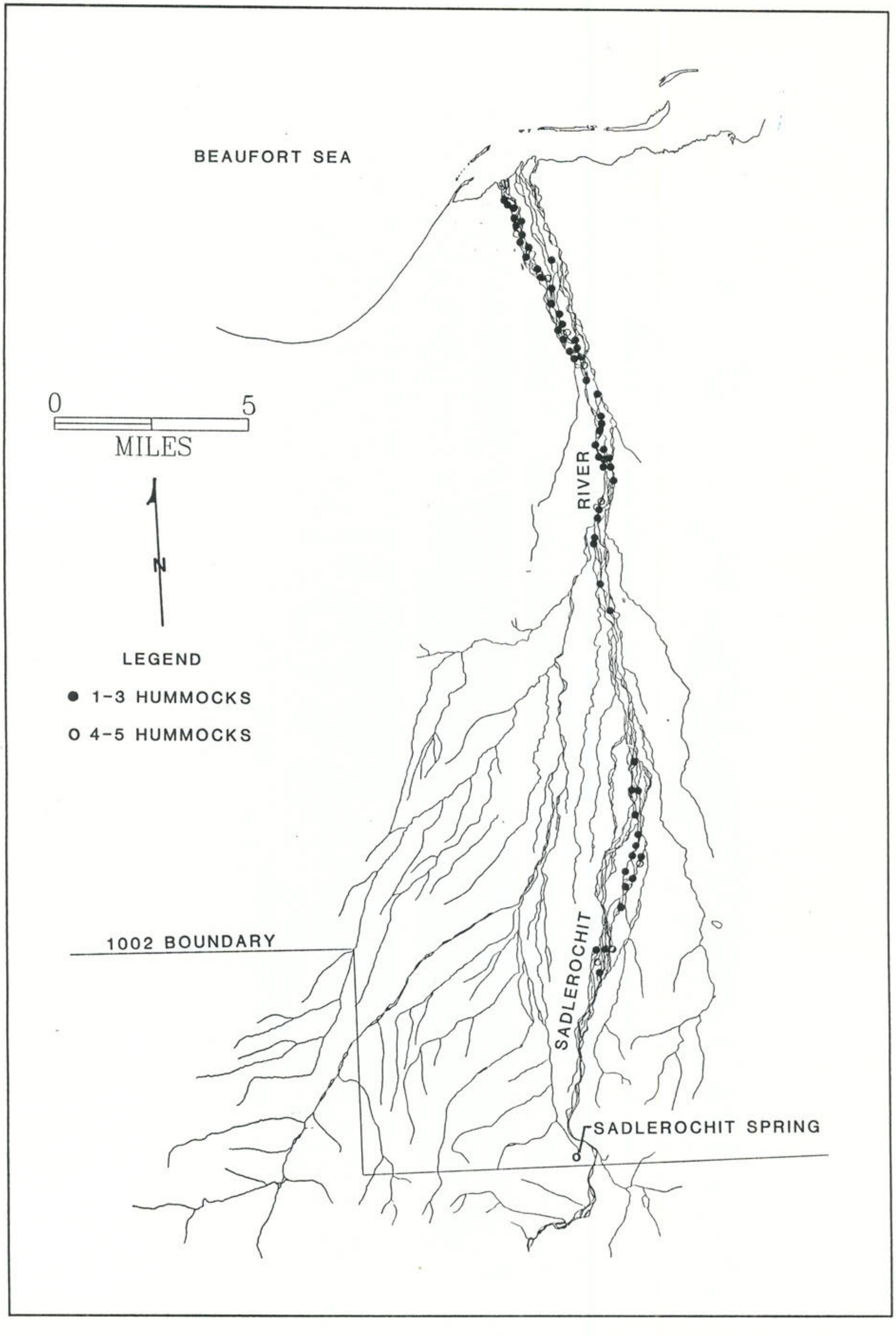

Figure 7.--Ice hummock locations in the Sadlerochit River drainage within the 1002 area, Arctic National Wildlife Refuge.

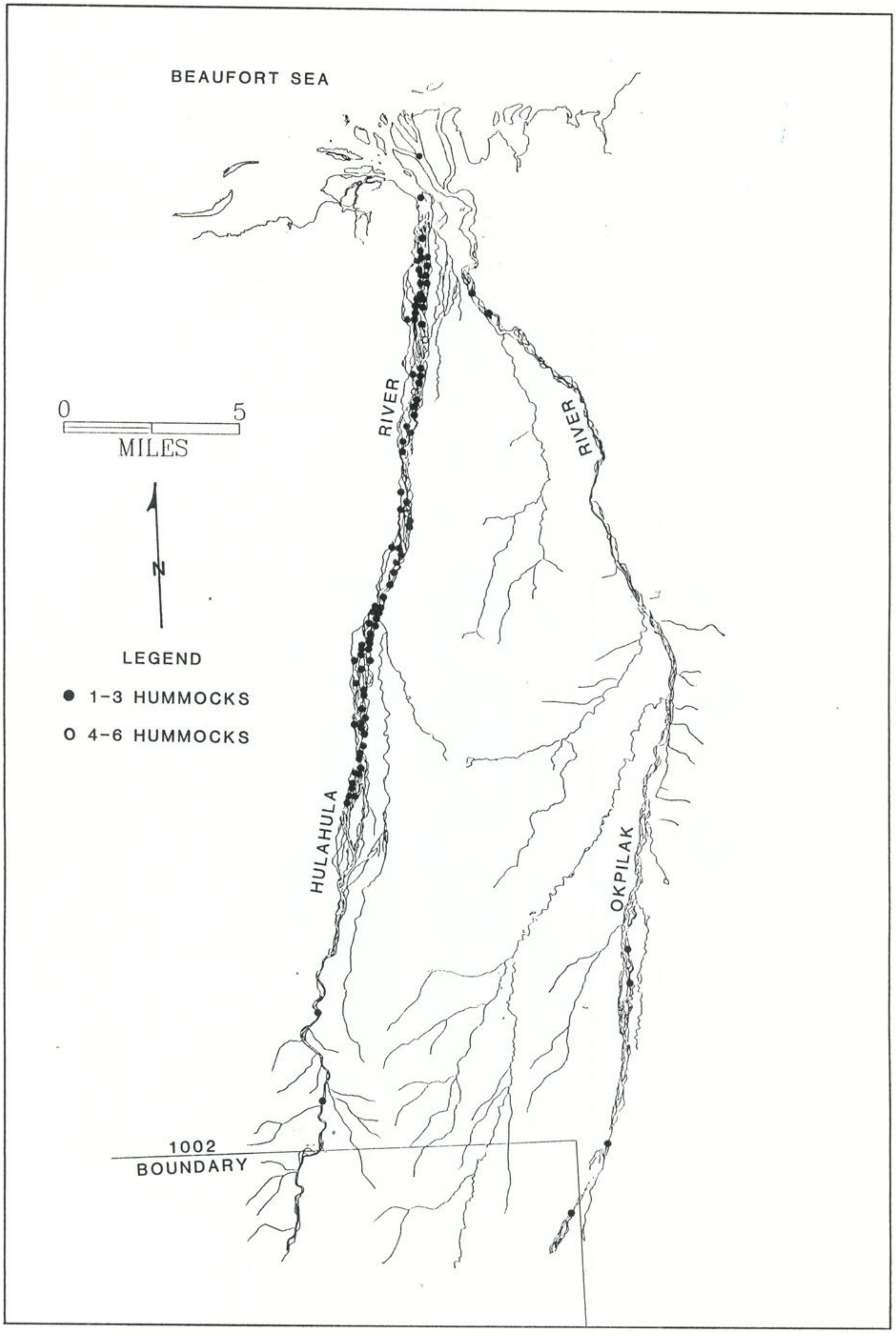

Figure 8.--Ice hummock locations in the Hulahula and Okpilak River drainages within the 1002 area, Arctic National Wildlife Refuge.

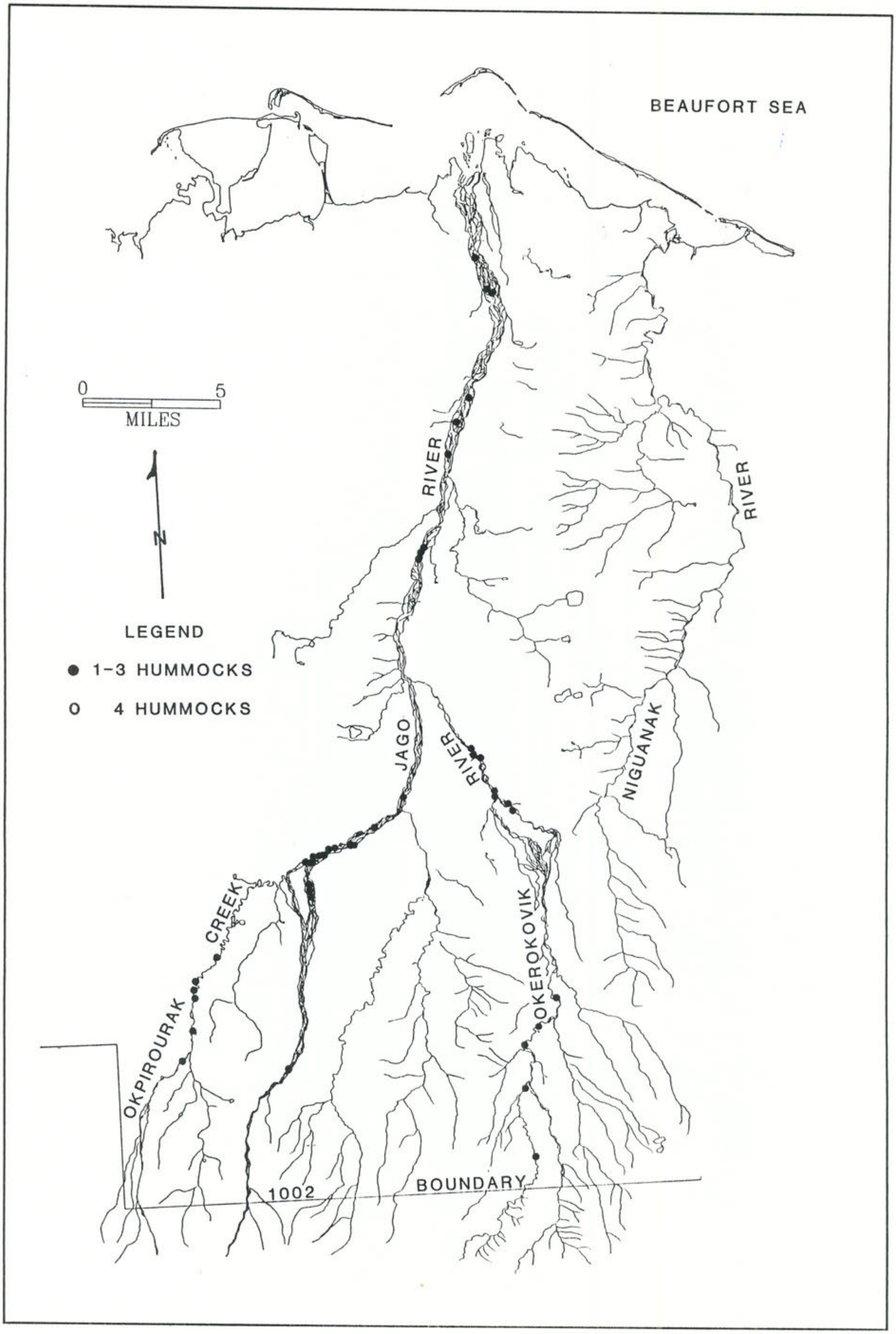

Figure 9.--Ice hummock locations in the Jago and Niguanak River drainages within the 1002 area, Arctic National Wildlife Refuge.

maintained. Ice thickness and water pool volumes may vary from year to year due to climatic factors.

Lakes provide a potentially more reliable source of water in the 1002 area than the water pools found along river sources (Elliott 1990). The estimated total amount of water available beneath all of the ice hummocks inventoried could be found beneath 4 ft of ice in 34 of the 52 lakes measured during 1989. The only other naturally occurring sources of winter water in the area are perennial springs. The largest spring in the 1002 area, Sadlerochit Spring, discharges an average of approximately 26 million gal per day (Lyons 1990).

Ice hummocks were also observed within all aufeisen identified within the 1002 area during this inventory. Alekseyev (1969) and Bukayev (1969) described the formation of hummocks within aufeisen (naleds) in Siberia. They proposed that the hummocks were the result of spring water that became pressurized when confined by layered naled ice and cracks in the hummocks were the points of release for water flowing to the naled surface. In addition to the seven aufeisen identified by Elliott (1989), another small icing was found on Okpirourak Creek in the Jago River drainage during this inventory. Hummocks observed within all aufeisen identified during 1989 were excluded from the inventory and volume measurements. It was assumed that the relationship used to estimate water pool volume for ice mounds over hydraulically isolated water pockets was different for ice mounds produced from the presence of flowing spring water.

Nekrasov (1969) described several ice hummocks in which layers of stream substrate were found within 6-12 inches of the ice surface. He postulated that hummocks formed over pools in the stream channel connected by subgravel flow which became pressurized from confinement between surface ice and frozen substrate. Two explanations were given to explain differences in the location and composition of substrate layers in the hummocks: 1) fine substrate particles were transported to the ice surface by pressurized water escaping through cracks over the deeper pools, and 2) coarser substrate was first contained in ice that froze to the stream bottom in shallower pools then was lifted by pressurized underground water. All ice hummocks described by Nekrasov (1969) were frozen to the substrate by mid May, as were two of the nine hummocks drilled during this study. In this study, four hummocks drilled for water pool delineation contained a layer of gravel and mud substrate approximately 2 ft from the ice surface. The location and composition of the substrate layers were closely approximated by the second explanation given by Nekrasov (1969), indicating a 2 ft layer of ice was frozen to the substrate when these hummocks began to form by lifting. Only one layer of gravel and mud substrate was observed in hummocks where this phenomenon occurred.

Water pressure beneath ice hummocks was reported to develop to the point where the stress resulted in the explosion of the top portion of the hummocks (Alekseyev 1969, Bogomolov and Sklyarevskaya 1969). One such explosion was heard nearly 4 mi away. Two of the water pools found beneath hummocks in this study were under enough pressure to force water out of the first hole

drilled. One of these was under extremely high pressure, forcing water over 10 ft into the air.

Ice hummocks are not necessarily associated with deeper pools or scour holes within primary river channels. The hydrolaccoliths described by Bogomolov and Sklyarevskaya (1969) were subsurface ice hummocks that formed beneath a layer of sand and grass. During the present study, willow branches were observed protruding from the top of several hummocks. The presence of willows suggests that hummocks and water pockets are not confined to active channels but sometimes form on or along the margin of vegetated islands within highly braided drainage systems. During September, 1989, the locations of five of the ice hummock study sites were revisited. Two of the sites (hummocks 3 and 7) were located within main river channels. One (hummock 4) was located on a gravel bar adjacent to a main river channel. One (hummock 1) was located within a backwater pool formed at the confluence of a small side channel and a main river channel. The location of the largest hummock (hummock 5) was at the edge of a small side channel separated from the nonvegetated floodplain by a vegetated island. The last site appeared to be at the location of a low volume spring or emergence of intergravel flow.

All of the rivers where ice hummocks were found contain fish, but fish use beneath hummocks is not reported. It is not known if fish inhabit the water pockets beneath ice hummocks. The only reported overwinter habitat used by fish within the 1002 area is associated with perennial springs. However, water beneath several of the hummocks was of suitable quality and quantity to provide overwinter habitat for fish.

There is a relatively small quantity of water beneath ice hummocks within river systems of the 1002 area. Future studies of potential winter water sources would be of more value if directed toward lakes and temporary reservoirs as potential sources of winter water.

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Appendix

Ice Hummock Measurements and Water Volume Estimates

Canning River ice hummock inventory data and water volume estimates, April 1989.

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)	Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
4	20	80	0	6	50	300	2,767
4	20	80	0	6	50	300	2,767
4	20	80	0	6	50	300	2,767
4	20	80	0	6	50	300	2,767
4	20	80	0	6	50	300	2,767
4	20	80	0	7	50	350	4,675
3	30	90	0	7	50	350	4,675
5	20	100	0	7	50	350	4,675
6	20	120	0	9	40	360	5,057
6	20	120	0	9	40	360	5,057
4	30	120	0	6	60	360	5,057
4	30	120	0	6	60	360	5,057
4	30	120	0	6	60	360	5,057
4	30	120	0	6	60	360	5,057
5	30	150	0	6	60	360	5,057
5	30	150	0	8	50	400	6,583
5	30	150	0	8	50	400	6,583
4	40	160	0	8	50	400	6,583
6	30	180	0	5	80	400	6,583
6	30	180	0	5	80	400	6,583
6	30	180	0	5	80	400	6,583
6	30	180	0	4	100	400	6,583
6	30	180	0	7	60	420	7,346
6	30	180	0	7	60	420	7,346
5	40	200	0	7	60	420	7,346
5	40	200	0	7	60	420	7,346
5	40	200	0	6	70	420	7,346
5	40	200	0	9	50	450	8,491
5	40	200	0	5	90	450	8,491
5	40	200	0	8	60	480	9,636
4	50	200	0	6	80	480	9,636
4	50	200	0	6	80	480	9,636
4	50	200	0	6	80	480	9,636
7	30	210	0	6	80	480	9,636
6	40	240	478	5	100	500	10,399
6	40	240	478	5	100	500	10,399
6	40	240	478	9	60	540	11,925
6	40	240	478	8	70	560	12,688
5	50	250	860	6	100	600	14,215
5	50	250	860	6	100	600	14,215
5	50	250	860	6	100	600	14,215
5	50	250	860	6	100	600	14,215
7	40	280	2,004	6	100	600	14,215
7	40	280	2,004	6	100	600	14,215
7	40	280	2,004	9	70	630	15,359
7	40	280	2,004	7	90	630	15,359
7	40	280	2,004	7	90	630	15,359
7	40	280	2,004	7	90	630	15,359

Canning River (continued)

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
8	80	640	15,741
8	80	640	15,741
7	100	700	18,030
7	100	700	18,030
7	100	700	18,030
7	100	700	18,030
7	100	700	18,030
7	100	700	18,030
7	100	700	18,030
7	100	700	18,030
9	80	720	18,793
9	80	720	18,793
8	90	720	18,793
6	120	720	18,793
5	150	750	19,938
8	100	800	21,846
8	100	800	21,846
9	90	810	22,228
7	120	840	23,372
7	120	840	23,372
10	90	900	25,662

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
9	100	900	25,662
6	150	900	25,662
6	150	900	25,662
6	150	900	25,662
6	150	900	25,662
8	120	960	27,951
5	200	1,000	29,477
7	150	1,050	31,385
8	150	1,200	37,109
6	200	1,200	37,109
9	150	1,350	42,832
9	150	1,350	42,832
7	200	1,400	44,740
8	180	1,440	46,266
6	250	1,500	48,556
8	200	1,600	52,372
8	200	1,600	52,372
8	250	2,000	67,634
9	250	2,250	77,174
8	400	3,200	113,423
7	600	4,200	151,580

Tamayariak River ice hummock inventory data and water volume estimates, April 1989.

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
2	40	80	0
2	40	80	0
2	40	80	0
2	40	80	0
2	50	100	0
2	50	100	0
4	30	120	0
4	40	160	0
4	50	200	0
4	50	200	0
4	50	200	0
4	50	200	0
2	100	200	0
6	40	240	478
4	60	240	478
8	30	240	478
5	50	250	860
8	35	280	2,004
6	50	300	2,767
6	50	300	2,767
6	50	300	2,767
6	50	300	2,767
6	50	300	2,767
6	50	300	2,767
7	50	350	4,675
6	60	360	5,057
6	60	360	5,057
4	90	360	5,057
6	60	360	5,057
8	50	400	6,583
7	60	420	7,346
5	100	500	10,399
4	200	800	21,846
8	100	800	21,846
8	100	800	21,846
8	100	800	21,846
8	100	800	21,846
8	100	800	21,846
8	100	800	21,846
8	100	800	21,846
8	100	800	21,846
8	100	800	21,846
6	150	900	25,662
8	200	1,600	52,372
7	300	2,100	71,450

Katakturuk River ice hummock inventory data and water volume estimates, April 1989.

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)	Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
4	20	80	0	6	80	480	9,636
4	20	80	0	5	100	500	10,399
6	30	180	0	5	100	500	10,399
6	30	180	0	4	150	600	14,215
4	50	200	0	6	100	600	14,215
4	50	200	0	8	80	640	15,741
4	50	200	0	7	100	700	18,030
4	50	200	0	7	100	700	18,030
4	50	200	0	7	100	700	18,030
4	50	200	0	9	80	720	18,793
4	50	200	0	5	150	750	19,938
5	40	200	0	5	150	750	19,938
6	40	240	478	5	150	750	19,938
4	60	240	478	8	100	800	21,846
6	50	300	2,767	8	100	800	21,846
6	50	300	2,767	8	100	800	21,846
6	50	300	2,767	10	80	800	21,846
6	50	300	2,767	8	100	800	21,846
6	50	300	2,767	8	100	800	21,846
6	50	300	2,767	4	200	800	21,846
6	50	300	2,767	4	200	800	21,846
6	50	300	2,767	6	150	900	25,662
6	60	360	5,057	9	100	900	25,662
6	60	360	5,057	9	100	900	25,662
4	100	400	6,583	8	150	1,200	37,109
5	80	400	6,583	6	200	1,200	37,109
6	70	420	7,346	7	200	1,400	44,740
6	80	480	9,636	10	150	1,500	48,556
6	80	480	9,636	8	200	1,600	52,372
6	80	480	9,636	10	200	2,000	67,634

Sadlerochit River ice hummock inventory data and water volume estimates, April 1989.

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
4	30	120	0
4	40	160	0
4	50	200	0
4	50	200	0
4	50	200	0
4	50	200	0
4	50	200	0
5	40	200	0
5	40	200	0
7	30	210	0
6	40	240	478
5	60	300	2,767
5	60	300	2,767
3	100	300	2,767
6	50	300	2,767
5	60	300	2,767
6	50	300	2,767
4	80	320	3,531
4	80	320	3,531
4	80	320	3,531
4	80	320	3,531
7	50	350	4,675
6	60	360	5,057
5	80	400	6,583
4	100	400	6,583
4	100	400	6,583
5	80	400	6,583
6	70	420	7,346
6	70	420	7,346
6	70	420	7,346
7	60	420	7,346
5	90	450	8,491
6	80	480	9,636
8	60	480	9,636
6	80	480	9,636
7	70	490	10,017
5	100	500	10,399
5	100	500	10,399
5	100	500	10,399
5	100	500	10,399
6	90	540	11,925
6	90	540	11,925
7	80	560	12,688
7	80	560	12,688
7	80	560	12,688
8	70	560	12,688
4	150	600	14,215
6	100	600	14,215
5	120	600	14,215
7	90	630	15,359
7	90	630	15,359
7	90	630	15,359
9	70	630	15,359
8	80	640	15,741
8	80	640	15,741
8	80	640	15,741
7	100	700	18,030
9	80	720	18,793
6	120	720	18,793
6	120	720	18,793
5	150	750	19,938
5	150	750	19,938
5	150	750	19,938
10	80	800	21,846
7	120	840	23,372
11	80	880	24,898
9	100	900	25,662
6	150	900	25,662
9	100	900	25,662
6	150	900	25,662
6	150	900	25,662
8	120	960	27,951
8	120	960	27,951
8	120	960	27,951
8	120	960	27,951
7	140	980	28,714
5	200	1,000	29,477
5	200	1,000	29,477
10	100	1,000	29,477
10	100	1,000	29,477
7	150	1,050	31,385
7	150	1,050	31,385
7	150	1,050	31,385
8	150	1,200	37,109
8	150	1,200	37,109
6	200	1,200	37,109
8	150	1,200	37,109
6	200	1,200	37,109
12	100	1,200	37,109
10	120	1,200	37,109
4	300	1,200	37,109
8	150	1,200	37,109
6	200	1,200	37,109
4	300	1,200	37,109

Sadlerochit River (continued)

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
10	120	1,200	37,109
5	250	1,250	39,017
5	250	1,250	39,017
9	150	1,350	42,832
9	150	1,350	42,832
8	180	1,440	46,266
5	300	1,500	48,556
8	200	1,600	52,372
8	200	1,600	52,372
8	200	1,600	52,372
8	200	1,600	52,372
7	250	1,750	58,095
9	200	1,800	60,003
9	200	1,800	60,003

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
8	250	2,000	67,634
10	200	2,000	67,634
8	250	2,000	67,634
5	400	2,000	67,634
8	250	2,000	67,634
7	300	2,100	71,450
8	300	2,400	82,897
8	300	2,400	82,897
7	350	2,450	84,805
7	350	2,450	84,805
5	500	2,500	86,713
12	250	3,000	105,791
9	350	3,150	111,515

Hulahula River ice hummock inventory data and water volume estimates, April 1989.

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)	Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
2	15	30	0	5	50	250	860
2	20	40	0	3	90	270	1,623
3	15	45	0	7	40	280	2,004
4	15	60	0	4	70	280	2,004
4	15	60	0	6	50	300	2,767
4	15	60	0	6	50	300	2,767
3	20	60	0	6	50	300	2,767
3	20	60	0	6	50	300	2,767
4	20	80	0	5	60	300	2,767
4	20	80	0	5	60	300	2,767
3	30	90	0	3	100	300	2,767
3	30	90	0	8	40	320	3,531
5	20	100	0	4	80	320	3,531
6	20	120	0	4	80	320	3,531
4	30	120	0	4	80	320	3,531
4	30	120	0	7	50	350	4,675
4	30	120	0	7	50	350	4,675
4	30	120	0	5	70	350	4,675
4	30	120	0	9	40	360	5,057
4	30	120	0	4	90	360	5,057
4	30	120	0	4	90	360	5,057
3	40	120	0	3	120	360	5,057
3	40	120	0	8	50	400	6,583
5	30	150	0	8	50	400	6,583
5	30	150	0	8	50	400	6,583
3	50	150	0	5	80	400	6,583
4	40	160	0	5	80	400	6,583
4	40	160	0	5	80	400	6,583
4	40	160	0	5	80	400	6,583
4	40	160	0	5	80	400	6,583
4	40	160	0	4	100	400	6,583
4	40	160	0	4	100	400	6,583
4	40	160	0	7	60	420	7,346
4	40	160	0	7	60	420	7,346
6	30	180	0	7	60	420	7,346
6	30	180	0	6	70	420	7,346
6	30	180	0	6	70	420	7,346
5	40	200	0	9	50	450	8,491
5	40	200	0	9	50	450	8,491
4	50	200	0	9	50	450	8,491
3	70	210	0	5	90	450	8,491
3	70	210	0	8	60	480	9,636
6	40	240	478	8	60	480	9,636
6	40	240	478	6	80	480	9,636
4	60	240	478	6	80	480	9,636
4	60	240	478	6	80	480	9,636
3	80	240	478	6	80	480	9,636
5	50	250	860	4	120	480	9,636

Hulahula River (continued)

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
4	120	480	9,636
7	70	490	10,017
5	100	500	10,399
5	100	500	10,399
5	100	500	10,399
9	60	540	11,925
6	90	540	11,925
6	90	540	11,925
6	90	540	11,925
6	90	540	11,925
8	70	560	12,688
8	70	560	12,688
7	80	560	12,688
7	80	560	12,688
4	140	560	12,688
6	100	600	14,215
6	100	600	14,215
5	120	600	14,215
5	120	600	14,215
5	120	600	14,215
4	150	600	14,215
7	90	630	15,359
7	90	630	15,359
7	100	700	18,030
8	90	720	18,793
6	120	720	18,793
6	120	720	18,793
4	180	720	18,793
5	150	750	19,938
5	150	750	19,938
8	100	800	21,846
8	100	800	21,846
8	100	800	21,846
8	100	800	21,846
4	200	800	21,846

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
7	120	840	23,372
7	120	840	23,372
7	120	840	23,372
6	140	840	23,372
6	150	900	25,662
6	150	900	25,662
6	150	900	25,662
6	150	900	25,662
5	180	900	25,662
8	120	960	27,951
8	120	960	27,951
8	120	960	27,951
8	130	1,040	31,004
7	150	1,050	31,385
9	120	1,080	32,530
6	180	1,080	32,530
10	120	1,200	37,109
8	150	1,200	37,109
6	200	1,200	37,109
4	300	1,200	37,109
5	250	1,250	39,017
7	200	1,400	44,740
7	200	1,400	44,740
7	200	1,400	44,740
7	200	1,400	44,740
7	200	1,400	44,740
5	300	1,500	48,556
8	200	1,600	52,372
8	200	1,600	52,372
9	180	1,620	53,135
7	250	1,750	58,095
7	250	1,750	58,095
6	300	1,800	60,003
6	300	1,800	60,003

Okpilak River ice hummock inventory data and water volume estimates, April 1989.

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)	Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
2	20	40	0	4	40	160	0
2	30	60	0	4	40	160	0
3	20	60	0	4	40	160	0
3	40	120	0	3	70	210	0
3	50	150	0	6	150	900	25,662

Jago River ice hummock inventory data and water volume estimates, April 1989.

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
3	15	45	0
3	20	60	0
3	20	60	0
3	20	60	0
2	30	60	0
4	20	80	0
4	20	80	0
4	20	80	0
4	20	80	0
2	40	80	0
4	30	120	0
4	30	120	0
4	30	120	0
4	30	120	0
3	40	120	0
3	40	120	0
3	50	150	0
3	50	150	0
3	50	150	0
3	50	150	0
3	50	150	0
3	50	150	0
4	40	160	0
3	60	180	0
5	40	200	0
4	50	200	0
4	50	200	0
4	60	240	478
4	60	240	478
4	60	240	478
3	80	240	478
3	80	240	478
5	50	250	860

Height (ft)	Length (ft)	Coeff (C)	Estim Volume (gal)
4	70	280	2,004
6	50	300	2,767
5	60	300	2,767
3	100	300	2,767
4	80	320	3,531
7	50	350	4,675
7	50	350	4,675
5	70	350	4,675
5	70	350	4,675
4	90	360	5,057
8	50	400	6,583
5	80	400	6,583
5	80	400	6,583
5	80	400	6,583
9	50	450	8,491
5	90	450	8,491
3	150	450	8,491
6	80	480	9,636
5	100	500	10,399
5	100	500	10,399
7	80	560	12,688
6	100	600	14,215
5	120	600	14,215
6	120	720	18,793
5	150	750	19,938
4	200	800	21,846
5	180	900	25,662
5	200	1,000	29,477
8	150	1,200	37,109
4	300	1,200	37,109
7	200	1,400	44,740
6	250	1,500	48,556

Alaska Fisheries Technical Report Number 10

DISTRIBUTION AND QUANTIFICATION OF WATER WITHIN THE LAKES OF THE 1002 AREA, ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA

May 1991

Region 7
U.S. Fish and Wildlife Service • Department of the Interior

Distribution and Quantification of Water Within the Lakes of the 1002 Area, Arctic National Wildlife Refuge, Alaska

John M. Trawicki
Steve M. Lyons
and
George V. Elliott

Water Resource Branch
Fisheries Management Services
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

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Abstract

An inventory of lake basins in the 1002 area of the Arctic National Wildlife Refuge was conducted as part of an effort to develop a hydrologic data base, map sources of water, and quantify water availability.

Using a recording fathometer, depth profile measurements were taken on 119 lakes within the 1002 area during the summer months of 1988, 1989, and 1990. Fathometer output was used to construct lake contour maps, calculate volumes, and estimate winter water volumes beneath ice cover.

Total estimated volume of the study lakes ranged from 55,382 acre-ft when free of ice to 3,366 acre-ft beneath seven feet of ice, the maximum ice thickness. In April, when ice thickness is at maximum, 90 percent of the available water is contained in nine of the 119 lakes surveyed. The lakes are not evenly distributed across the 1002 area. A large number of lakes are congregated near the mouth of the Canning River, and only two lakes are located in the region between the Katakturuk and Sadlerochit Rivers.

During the winter months, winter water is more abundant in lakes than in pools located beneath ice hummocks along major river drainages of the 1002 area.

Observation of fish presence in lakes was more frequent and widespread than previously suspected. Ninespine stickleback (Pungitius pungitius) were found in 34 of the 52 lakes (65%) surveyed in 1989.

The correct citation for this publication is:

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Introduction

The location and quantity of water from natural lakes in the 1002 area of the Arctic National Wildlife Refuge (ANWR) were evaluated to identify water availability throughout the year (Figures 1 and 2). Information on the spatial and temporal distribution of potential water sources is required to make informed decisions concerning the management of potential oil and gas development so as to best protect aquatic habitats and the fish and wildlife species that use them.

The availability of water during winter months is influenced by extremely low air temperatures and short, cool summers. Total annual precipitation averages 6.2 inches on Barter Island (Arctic Environmental Information and Data Center 1986). Ninety-nine percent of the 1002 area is classified as wetlands. However, water is limited and confined to the shallow zone above permafrost (Clough et al. 1987). Lake depth also influences winter water availability. Clough et al. (1987) reported that most lakes have basins less than 7 ft deep and freeze to the bottom by late winter. Wilson et al. (1977) reported that maximum ice thickness in Arctic lakes normally does not exceed 6.6 ft except in extremely severe winters.

Winter water availability and distribution within the 1002 area is an important factor to consider with respect to the potential large scale oil and gas exploration activities being considered in the 1002 area. Wilson et al. (1977) and Clough et al. (1987) reported that the average water demands in the Prudhoe Bay area for oil and gas exploration were:

Geophysical exploration....................	0.003 acre-ft/day/crew
Exploratory drilling......................	0.09 acre-ft/day/crew
Base camp (75 men)........................	0.02 acre-ft/day
Ice road construction and maintenance.......	4.1 acre-ft/mi
Ice airstrip construction and maintenance...	21.5 acre-ft

According to Clough et al. (1987), it is estimated that 46 acre-ft of water would be required to build and support a single exploratory well. Note that ice road construction is the largest consumer of available winter water should oil and gas exploration occur.

Few lakes in the 1002 area have been measured to determine their depth or volume. West and Fruge (1989) estimated the depth of nine study lakes based on fetch along the direction of prevailing winds (Carson and Hussey 1962). Three of the nine lakes were estimated to be deeper than 5.9 ft; two of these lakes are located on Kaktovik Inupiat Corporation lands. Childers et al. (1977) reported water depth and ice thickness for six lakes within the 1002 area. The total depth, including ice thickness, ranged from 6.2 to 10.0 ft. Three of these lakes are on Kaktovik Inupiat Corporation lands.

Water depth is thought to restrict the presence of fish in Arctic lakes during the winter. Hobbie (1984) found fish only to be present in lakes with depths greater than 5.6 ft. Within the 1002 Area, Ward and Craig (1974) sampled 14 lakes along the Canning River and found fish present in six of the lakes, including broad whitefish (Coregonus nasus), round whitefish (Prosopium cylindraceum), Arctic grayling(Thymallus arcticus), Arctic char (Salvelinus

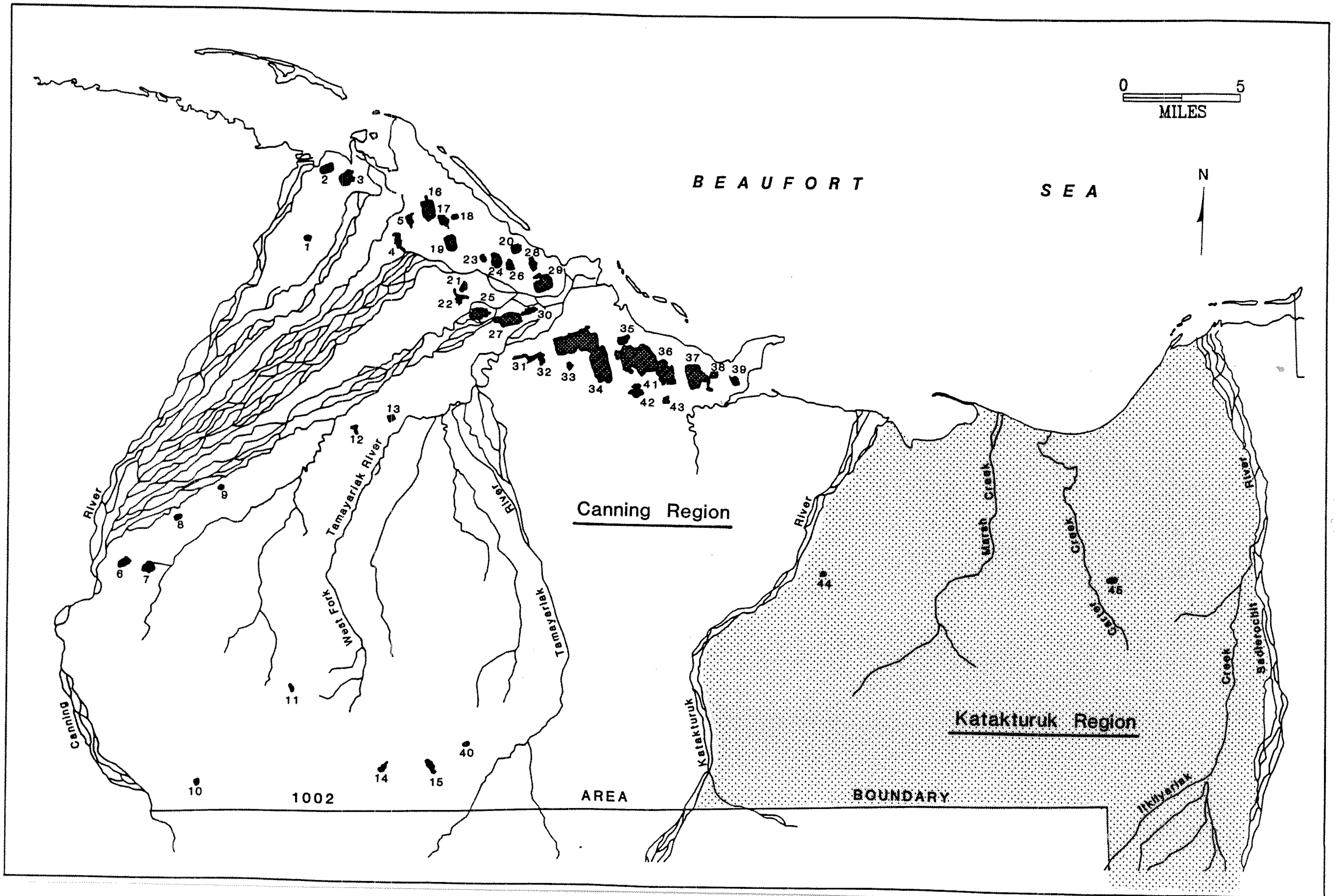

Figure 1.-Map of lakes on the western portion of the 1002 area, Arctic National Wildlife Refuge.

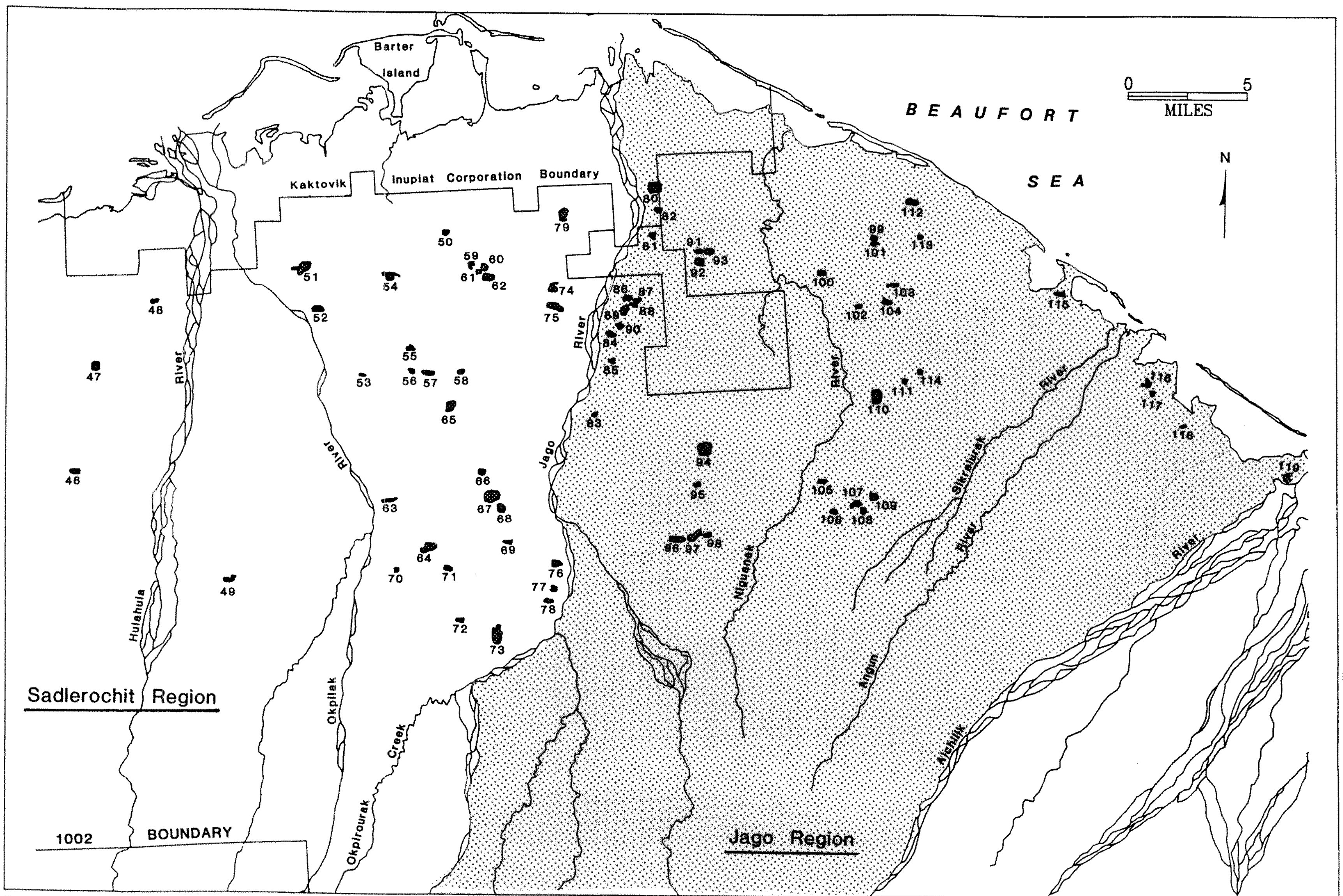

Figure 2.-Map of lakes on the eastern portion of the 1002 area, Arctic National Wildlife Refuge.

alpinus), ninespine stickleback (Pungitius pungitius), and Arctic flounder (Liopsetta glacialis). West and Fruge (1989) found ninespine stickleback present in three of nine lakes sampled within the 1002 Area.

The objectives of this study were to quantify the volume of water, including winter water, in lakes of the 1002 area with surface areas near or greater than 25 acres. Winter water is defined as water in its liquid phase. The second objective was to examine the distribution of these lakes. This final report summarizes the data collected during 1988-1990.

Methods

One hundred and nineteen lakes were studied within the 1002 area of the ANWR. Lakes were identified from U.S. Geological Survey (1:63,360) maps. These 119 lakes are the largest lakes within the 1002 Area. Lakes that were not surveyed were considered to be to small or to shallow to be included in the study. Transect data was collected on the two largest lakes in 1988. In 1989, transect data were collected on 52 of the larger lakes and the remaining 65 lakes were surveyed in 1990. Because the lakes in the 1002 area are unnamed, they are identified by legal locations and latitude-longitude map coordinates (Appendix A). Note that lake numbers identified in Elliott (1990) have been changed to include the lake transect data from 1990, thus allowing lakes to be grouped by geographic location.

Water depth was measured along a minimum of 6 transects across each lake, using a recording fathometer mounted on the back of an inflatable boat. A constant throttle setting was used for each transect. The goal was to run three parallel transects dividing the lake into quarters along one axis. Then three more transects were run perpendicular to the original transects, also splitting the lake into quarters. Transect configuration was often altered because of irregular shape or size of the lake.

In 1989, several soundings were taken at each lake using a weighted line to develop a calibration factor for the depth recorded by the fathometer. Sounding depths were read to the nearest 0.1 ft. The depths recorded on the fathometer strip charts were adjusted to true depth soundings using a mylar overlay scribed with the strip chart scale. The overlay scale was placed over the strip chart records and aligned to calibration depth records marked on the strip chart. The location of each 1 ft depth contour interval was then identified along each transect using the overlay scale (Elliott 1990).

In 1990, several depth measurements were taken to the nearest 0.1 ft at the beginning of each set of transects using a weighted line. Soundings taken by the fathometer were then calibrated to the measurements of the weighted line. Calibration information was recorded on the strip chart before any transects were run. Lakes with maximum depths less then 2.5 ft were not measured in the field. The volumes of these shallow lakes were estimated using surface area measurements from enlarged U.S. Geological Survey maps and maximum depth estimates made by the surveyors.

Lake shoreline maps were made from approximately 9X enlargements of 1:63,360 scale U.S. Geological Survey topographic maps. Contour interval locations were placed on lake maps using the proportion of chart transect length to map transect length. Contour lines were drawn on each lake map through corresponding points of depth. The area within each 1 ft contour was read to the nearest 0.001 in² using a planimeter. The planimeter reading was then converted to the nearest 1 acre based on the lake map scale. Lake volume was calculated using the formula (Welch 1948):

$$V = \Sigma [h/3 \ (a_1 + a_2 + \sqrt{a_1 a_2})]$$

where, V = lake volume (acre-ft)
h = strata height (ft)
a_1 = area of top surface of strata (acres)
a_2 = area of bottom surface of strata (acres)

Water volumes during winter were calculated by subtracting 1 ft strata volumes from the ice-free volume to estimate volume of water beneath successive 1 ft layers of ice. Dates that ice thickness reached the 1 ft intervals were approximated from averaged data of ice thickness over time for Barter Island Lake reported by Bilello and Bates (1969, 1971, 1972, and 1975), representing eight years of record.

For the purpose of analysis the 1002 area was broken into four geographic regions. Summarizing the data by geographic region illuminates the uneven distribution of lakes across the coastal plain. All lakes surveyed between the Canning and Katakturuk Rivers (lake #1-43) make up the Canning region. Lakes located between the Katakturuk and Sadlerochit Rivers comprise the Katakturuk region (lake #44-45). The Sadlerochit region (lake #46-79) is located between the Sadlerochit and Jago Rivers. The Jago region extends east from the Jago River, to the eastern boundary of the 1002 area (lake #80-119).

In 1989, each lake was examined for the presence of fish during August. The margins of several lakes were visually inspected to determine the most heavily used shoreline habitat type. All of the lakes were then sampled along selected shoreline areas using a long handled dip net. All fish captured were identified to species (Elliott 1990). No fish sampling was conducted on lakes during 1990.

In 1989, the maximum fetch distance parallel to prevailing wind direction (approximately WSW-ENE) was measured to the nearest 100 ft from enlargements of 1:63,360 scale topographic maps. The relationship between lake depth and maximum fetch distance was determined using simple linear regression (Elliott 1990).

Results

Of the 119 lakes surveyed, surface areas averaged 90 acres and ranged from 0 to 1,533 acres (Appendix B). Maximum depths recorded for individual lakes ranged from 0 to 24.8 ft with an average of 6.7 ft. Fifty-nine of the lakes

surveyed had a maximum depth that exceeded 7.0 ft. Four of the 119 lakes identified on the U.S. Geological Survey maps were either dry or contained less than one foot of water. These dry lakes have been included in the data base and account for areas and volumes equal to zero.

Individual lake volumes during ice-free conditions ranged from 0 to 9,285 acre-ft. Total lake volume for the 119 lakes measured was 55,379 acre-ft. In early January, when ice thickness is approximately four feet, lake water volume totaled 17,755 acre-ft from 85 lakes. By mid-April, when ice thickness reaches its maximum of 7 ft, 60 of the 119 lakes will freeze to bottom. The remaining 59 lakes contain a total water volume of 3,365 acre-ft. At maximum ice development of 7 ft, only nine lakes (lake #s 2, 6, 14, 27, 34, 36, 76, 80, and 119) contain at least 50 acre-ft of winter water, the approximate minimum volume required to support a exploratory well site. These nine lakes comprise 90 percent of the available winter water in lakes.

Canning Region: The distribution of winter water in lakes is heavily skewed in the 1002 area. The largest volume of winter water, 64 to 80 percent, depending on ice thickness (Table 1), is located in the Canning region (lakes #1-43). Within the Canning region lakes tend to be clustered near the mouth of the Canning River. At an ice thickness of 7 ft, 48 percent of the available water in the Canning region is located in one lake, while 92 percent is in only five lakes. With ice thicknesses of 0, 4, and 7 ft there are 39, 20, and 6 lakes respectively that contain 50 acre-ft of water or more.

Katakturuk Region: There were only two lakes (lake #44 and #45) between the Katakturuk and Sadlerochit Rivers (Katakturuk region) with surface areas great enough to be included in this survey. These two lakes contained less then one percent of all the available water regardless of ice presence and thickness. Only one lake contained more than 50 acre-ft of water, and with an ice thickness of 7 ft, this region contains less than 10 acre-ft of winter water.

Table 1.--Volume and percent of total 1002 Area lake water surveyed, by region, at ice thicknesses of zero, four, and seven feet. The date of average ice-thickness is in parenthesis.

		0 ft Ice		4 ft Ice (Jan 4)		7 ft Ice (Apr 16)	
Region	No. Lakes	Volume (acre-ft)	Percent of Total	Volume (acre-ft)	Percent of Total	Volume (acre-ft)	Percent of Total
Canning	43	35,541	64.2	12,378	69.7	2,669	79.3
Katakturuk	2	339	0.6	93	0.5	6	0.2
Sadlerochit	34	9,959	18.0	2,504	14.1	186	5.5
Jago	40	9,543	17.2	2,783	15.7	505	15.0
Totals	119	55,382	100.0	17,758	100.0	3,366	100.0

Sadlerochit Region: Five to 18 percent of the water surveyed was located in the 34 surveyed lakes in the Sadlerochit region (lake #46-79). The lakes in this region are concentrated and well distributed in the northern half and east of the Okpilak River. All lakes along the coast in this section are on Kaktovik Inupiat Corporation land and were not surveyed. Again, the water is not evenly distributed within the Sadlerochit region. With 0, 4, and 7 ft of lake ice, there are 33, 15, and 1 lakes, respectively, that contain 50 acre-ft of water or more.

Jago Region: A total of 9,543 acre-ft of water was found in the 40 lakes surveyed in the Jago region. The largest concentrations of lakes were found along the Jago and Niguanak Rivers. In the Jago region, with four feet of lake ice, there is 2,783 acre-ft of water available and only 10 lakes with greater than 50 acre-ft of winter water. With 7 ft of lake ice there are only two lakes with more than 50 acre-ft of water volume required to support an exploratory well site.

Additional Results: Ninespine stickleback were captured in 34 of the 52 lakes surveyed in 1989. No other species were captured. Fish were not sampled during the 1990 survey, but fish were observed in lake numbers four and five. Fish captured in 1989 were limited to two areas, between the Canning and Katakturuk Rivers and between the Okpilak and Aichilik Rivers. No fish were found in the central portion of the 1002 area between the Katakturuk and Opilak Rivers. Fish were found in 83 percent of the lakes with depths greater than 7 ft and in 43 percent of the lakes with depths less than 7 ft deep (Elliott 1990).

Of the 54 lakes inventoried in 1989, 45 lakes were within the range of the fetch distances reported by Carson and Hussey (1962) illustrating "the ideal depth-fetch relationship." However, the depth of 41 of the 45 lakes was underestimated by this relationship. Only 14, or 31 percent, of the 45 lakes were within $\pm$ 2 ft of the ideal relationship. Elliott (1990) found that there was no relationship (r^2=0.05) between lake depth and maximum fetch distance (n=45) in the 1002 Area.

Discussion

Lake depths measured during this study were consistently greater than depths estimated and measured for the same lakes investigated during previous studies. Childers et al. (1977) measured ice surface to lake bottom depths of 6.2, 7.3, and 7.5 ft in three lakes for which maximum depths of 6.4, 9.0, and 8.5 ft, respectively, were measured during this inventory. However, measurements by Childers et al. (1977) were taken at only a single point in each lake.

Lakes provide a more abundant source of winter water than naturally occurring water pools found in rivers (Elliott and Lyons 1990). The total estimated volume of water beneath ice hummocks in the 1002 area during 1989 was estimated to be 27 acre-ft (Elliott and Lyons 1990). Winter water availability in lakes ranges from 55,379 acre-ft in October to 3,366 acre-ft

in April. The only other naturally occurring winter water source available are perennial springs. The largest spring in the 1002 area, Sadlerochit Spring, discharges 35 cfs or 70 acre-ft per day during winter months (Lyons 1990).

Timing and distribution of water in the 1002 area is a critical factor to consider in regard to oil and gas exploration. In an average year, ice begins forming on lakes by early October; by mid-December more than half the available water volume has been frozen, reducing the winter water from approximately 55,000 acre-ft to approximately 25,000 acre-ft (Figure 3).

Wilson et al. (1977) and Clough et al. (1987) estimated that a single exploratory well site would require a minimum of 46 acre-ft of water. Ice road construction also requires large volumes of winter water, 4.1 acre-ft per mile (Wilson et al. 1977; Clough et al. 1987; and Elliott and Lyons 1990). Since lakes in the 1002 area are unevenly distributed, winter water that might be used for ice road construction is not uniformly available. A large concentration of lakes occur near the mouth of the Canning River and a fairly good distribution of lakes occur within 20 miles of the coast between the Hulahula and Niguanak Rivers (Figures 1 & 2). Distribution of lakes in the remaining regions of the 1002 area is sparse and widespread.

Water quality of lakes in the Arctic is generally good during summer months (Sloan 1987) with the exception of shallow lakes and lakes located along the coast. Shallow lakes are often turbid because of the continual disturbance of bottom sediments caused by wave action (Sloan 1987). Lakes located near the coast are subject to high concentration of dissolved solids due to sea spray or salt water intrusions (Sloan 1987). Clough et al.(1987), Sloan (1987), and Wilson et al. (1977) reported that as ice thickness increases, there is an increase in the concentrations of dissolved ions and organic matter, and that dissolved oxygen concentrations are depressed due to the lack of aeration and limited photosynthesis during winter months. Clough et al. (1987) noted that changes in water quality are dependent on the ratio of water to ice and that shallow lakes that freeze nearly to the bottom are unpotable.

Carson and Hussey (1962) estimated lake depth based on fetch along the direction of prevailing winds. The Arctic Coastal Plain province is divided into two sections, the Teshekpuk section which is characterized by flat topography, and the White Hills section which is characterized by scattered groups of low hills (Wahrhaftig 1965). The "oriented lakes" discussed by Carson and Hussey (1962) are found in the Teshekpuk section, which extends into the 1002 Area only near the mouth of the Canning River. Most of the lakes in the 1002 Area are within the White Hills section of the Arctic Coastal Plain province and their shape is defined more by topography than prevailing wind direction.

Fish distribution in 1002 area lakes is much more widespread than previously reported. Elliott (1990) reported capturing ninespine stickleback in 34 of the 52 lakes surveyed in 1989. These fish were found in lakes throughout the 1002 area with the exception of the region between the Katakturuk and Okpilak Rivers. Fish were captured in 30 and observed in two lakes for which there was no previous record of fish presence.

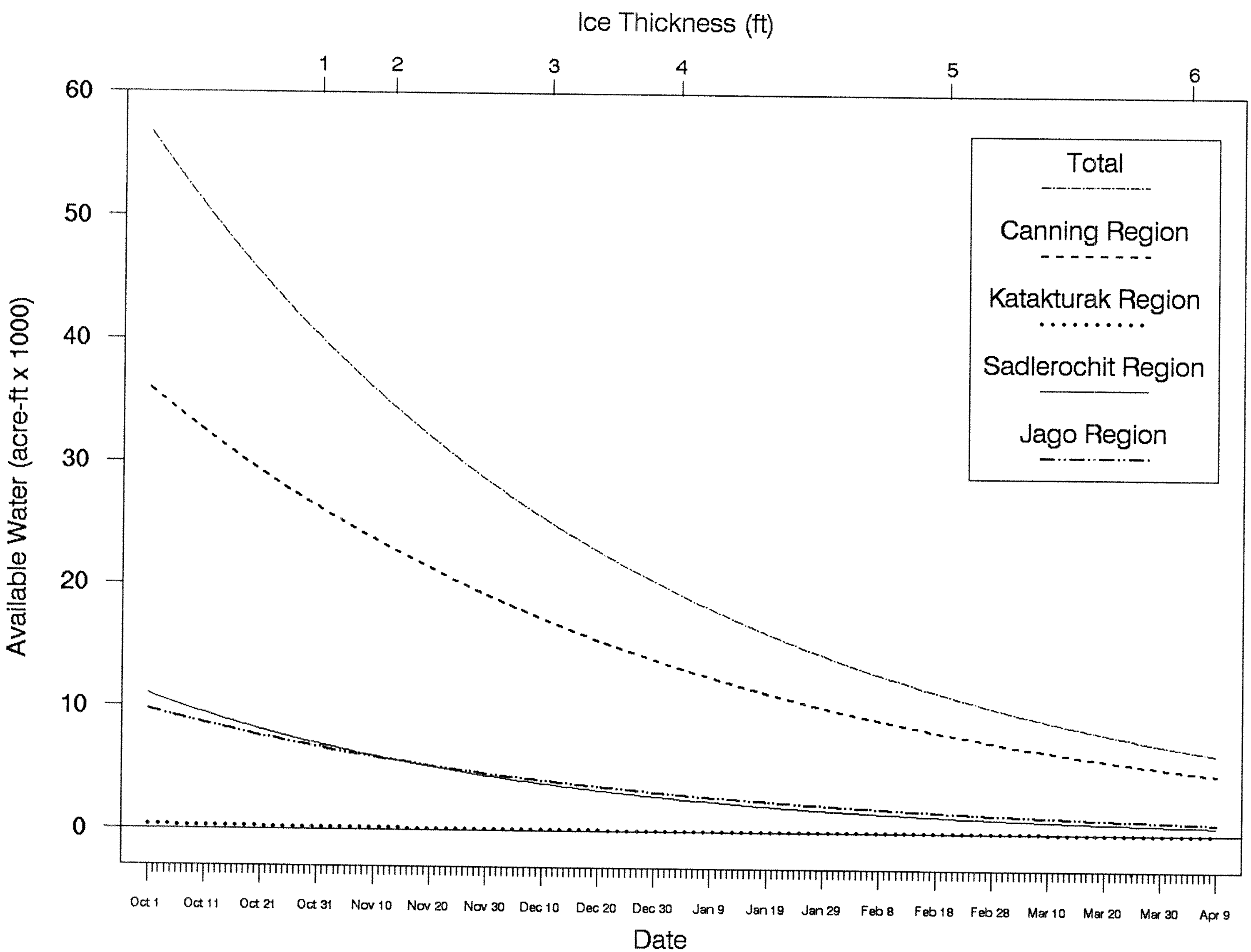

Figure 3.-Volume of available water from lakes within the 1002 area of the Arctic National Wildlife Refuge during winter months.

Conclusions

Lakes deeper than 7 ft can serve as winter habitat for fish (Elliott 1990). The withdrawal of water from lakes inhabited by fish should be considered on a case by case basis, taking into account the amount of water necessary for overwinter survival. If there are no environmental concerns with a lake freezing to the substrate, larger volumes of water are available by removing the water prior to maximum ice development. For example, 152 acre-ft instead of 29 acre-ft could be obtained from lake #46 prior to January 4, before ice thickness reaches 4 ft (Table 1). Using this criterion, lakes shallower than 7 ft, which do not support fish, could also be used as a winter water source.

Since fish sampling was limited to dipnets and no sampling was conducted in 1990, it is recommended that all lakes be surveyed for fish presence prior to using the lake as a winter water source.

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Appendix A

Legal descriptions of study lake locations

Appendix A.--Legal descriptions of study lake locations.

Lake Number	Map Location	Latitude	Longitude
	Flaxman Island (A-4)*		
1	NE¼ SW¼ Sec. 34, T.9N., R.24E.	70°05'54"	146°56'36"
2	NE¼ SW¼ Sec. 14, T.9N., R.24E.	70°08'00"	145°57'18"
3	SW¼ SW¼ Sec. 13, T.9N., R.24E.	70°07'36"	145°56'36"
4	NE¼ SW¼ Sec. 32, T.9N., R.25E.	70°05'24"	145°51'12"
5	NW¼ SE¼ Sec. 29, T.9N., R.25E.	70°06'06"	145°50'00"
	Mt. Michelson (D-4)*		
6	SW¼ NW¼ Sec. 11, T.6N., R.23E.	69°53'30"	146°20'28"
7	NW¼ SW¼ Sec. 12, T.6N., R.23E.	69°53'20"	146°17'58"
8	SW¼ NW¼ Sec. 31, T.7N., R.24E.	69°55'08"	146°14'55"
9	NW¼ NW¼ Sec. 28, T.7N., R.24E.	69°56'14"	146°10'08"
10	SE¼ SE¼ Sec. 30, T.5N., R.24E.	69°45'21"	145°12'57"
11	NW¼ SW¼ Sec. 1, T.5N., R.24E.	69°48'51"	146°02'57"
12	NE¼ SE¼ Sec. 8, T.7N., R.25E.	69°58'22"	145°55'55"
13	NE¼ NW¼ Sec. 10, T.7N., R.25E.	69°58'46"	145°52'10"
14	NW¼ NE¼ Sec. 28, T.5N., R.25E.	69°45'58"	145°53'40"
15	SW¼ SE¼ Sec. 23, T.5N., R.25E.	69°46'00"	145°48'36"
	Flaxman Island (A-3)*		
16	SW¼ NE¼ Sec. 28, T.9N., R.25E.	70°06'30"	145°48'00"
17	NW¼ SW¼ Sec. 27, T.9N., R.25E.	70°06'12"	145°46'06"
18	NW¼ SW¼ Sec. 27, T.9N., R.25E.	70°06'18"	145°44'54"
19	NE¼ SW¼ Sec. 34, T.9N., R.25E.	70°05'18"	145°45'18"
20	SE¼ SW¼ Sec. 31, T.9N., R.26E.	70°04'30"	145°39'12"
21	NW¼ SE¼ Sec. 7, T.8N., R.26E.	70°03'42"	145°44'06"
22	NE¼ NW¼ Sec. 18, T.8N., R.26E.	70°03'18"	145°44'30"
23	SE¼ NW¼ Sec. 5, T.8N., R.26E.	70°04'42"	145°41'54"
24	SE¼ NE¼ Sec. 5, T.8N., R.26E.	70°04'36"	145°40'36"
25	NW¼ SW¼ Sec. 17, T.8N., R.26E.	70°02'41"	145°42'45"
26	NW¼ SE¼ Sec. 4, T.8N., R.26E.	70°04'30"	145°39'12"
27	SE¼ SW¼ Sec. 16, T.8N., R.26E.	70°02'27"	145°39'30"
28	NW¼ SE¼ Sec. 3, T.8N., R.26E.	70°04'30"	145°36'48"
29	NE¼ SE¼ Sec. 10, T.8N., R.26E.	70°03'48"	145°35'48"
30	NE¼ SW¼ Sec. 15, T.8N., R.26E.	70°02'48"	145°37'12"
31	NE¼ SW¼ Sec. 27, T.8N., R.26E.	70°58'00"	145°37'28"
32	SW¼ SE¼ Sec. 27, T.8N., R.26E.	70°00'54"	145°36'06"
33	NW¼ NE¼ Sec. 35, T.8N., R.26E.	70°00'42"	145°33'06"
34	SE¼ SE¼ Sec. 24, T.8N., R.26E.	70°01'35"	145°31'15"
35	NE¼ SW¼ Sec. 20, T.8N., R.27E.	70°01'48"	145°27'30"
36	NW¼ SW¼ Sec. 28, T.8N., R.27E.	70°01'05"	145°22'55"

Appendix A.--Continued

Lake Number	Map Location	Latitude	Longitude
	Flaxman Island (A-3)*		
37	SW¼ NW¼ Sec. 35, T.8N., R.27E.	70°24'00"	145°20'00"
38	SW¼ NW¼ Sec. 36, T.8N., R.27E.	70°00'10"	145°18'00"
39	SE¼ SE¼ Sec. 36, T.8N., R.27E.	70°00'00"	145°15'42"
	Mt. Michelson (D-3)*		
40	NE¼ NW¼ Sec. 19, T.5N., R.26E.	69°46'48"	145°44'45"
41	SE¼ SE¼ Sec. 32, T.8N., R.27E.	70°00'00"	145°26'18"
42	NE¼ NE¼ Sec. 5, T.7N., R.27E.	69°59'43"	145°26'20"
43	SW¼ NW¼ Sec. 3, T.7N., R.27E.	69°59'24"	145°23'06"
	Mt. Michelson (D-2)*		
44	SW¼ SE¼ Sec. 10, T.6N., R.28E.	69°52'54"	145°06'48"
45	SW¼ NE¼ Sec. 15, T.6N., R.30E.	69°52'33"	144°36'18"
	Mt. Michelson (D-1)*		
46	NE¼ NE¼ Sec. 13, T.6N., R.31E.	69°52'50"	144°15'40"
47	SW¼ SW¼ Sec. 20, T.7N., R.32E.	69°56'34"	144°13'08"
48	NW¼ NE¼ Sec. 10, T.7N., R.32E.	69°58'48"	144°06'42"
49	SW¼ SW¼ Sec. 6, T.5N., R.33E.	69°48'36"	144°20'00"
	Barter Island (A-5)*		
50	NE¼ SE¼ Sec. 27, T.8N., R.34E.	70°00'54"	145°35'42"
	Demarcation Point (D-5)*		
51	NE¼ NE¼ Sec. 3, T.7N., R.33E.	69°59'52"	143°50'52"
52	SE¼ SW¼ Sec. 11, T.7N., R.33E.	69°58'18"	143°49'43"
53	NW¼ SW¼ Sec. 30, T.7N., R.34E.	69°55'54"	143°45'18"
54	NE¼ SE¼ Sec. 5, T.7N., R.34E.	69°59'24"	143°41'55"
55	NW¼ SW¼ Sec. 21, T.7N., R.34E.	69°56'48"	143°40'06"
56	SW¼ NW¼ Sec. 28, T.7N., R.34E.	69°56'00"	143°40'00"
57	NE¼ SE¼ Sec. 28, T.7N., R.34E.	69°55'54"	143°38'30"
58	NW¼ SW¼ Sec. 26, T.7N., R.34E.	69°55'54"	143°34'54"
59	SE¼ NE¼ Sec. 2, T.7N., R.34E.	69°59'42"	143°33'12"
60	SW¼ NE¼ Sec. 1, T.7N., R.34E.	69°59'36"	143°31'54"
61	NE¼ SW¼ Sec. 1, T.7N., R.34E.	69°59'24"	143°32'30"
62	SW¼ SE¼ Sec. 1, T.7N., R.34E.	69°59'11"	143°31'30"
63	SE¼ SE¼ Sec. 19, T.6N., R.34E.	69°51'24"	143°43'06"

Appendix A.--Continued

Lake Number	Map Location	Latitude	Longitude
	Demarcation Point (D-5)*		
64	SW¼ SE¼ Sec. 33, T.6N., R.34E.	69°49′34″	143°39′22″
65	NE¼ NE¼ Sec. 3, T.6N., R.34E.	69°54′40″	143°36′13″
66	SE¼ SE¼ Sec. 14, T.6N., R.34E.	69°52′12″	143°33′12″
67	SE¼ SW¼ Sec. 24, T.6N., R.34E.	69°51′20″	143°32′30″
68	SW¼ NE¼ Sec. 25, T.6N., R.34E.	69°50′51″	143°31′32″
69	SE¼ SE¼ Sec. 36, T.6N., R.34E.	69°49′36″	143°31′06″
70	SW¼ SW¼ Sec. 5, T.5N., R.34E.	69°48′48″	143°42′54″
71	SE¼ SW¼ Sec. 3, T.5N., R.34E.	69°48′48″	143°37′30″
72	NW¼ NE¼ Sec. 22, T.5N., R.34E.	69°46′54″	143°36′36″
73	NW¼ SW¼ Sec. 24, T.5N., R.34E.	69°46′14″	143°32′50″
74	SE¼ NW¼ Sec. 9, T.7N., R.35E.	69°58′40″	143°24′50″
75	NE¼ NW¼ Sec. 16, T.7N., R.35E.	69°58′00″	143°24′40″
76	SW¼ SE¼ Sec. 5, T.5N., R.35E.	69°48′45″	143°26′22″
77	SW¼ SE¼ Sec. 8, T.5N., R.35E.	69°47′54″	143°26′36″
78	SE¼ NW¼ Sec. 17, T.5N., R.35E.	69°47′24″	143°27′18″
	Barter Island (A-4)*		
79	NE¼ NE¼ Sec. 28, T.8N., R.35E.	70°01′23″	143°23′20″
80	SE¼ NE¼ Sec. 19, T.8N., R.36E.	70°02′11″	143°13′25″
81	SW¼ NW¼ Sec. 31, T.8N., R.36E.	70°01′24″	143°14′06″
82	SW¼ NW¼ Sec. 29, T.8N., R.36E.	70°01′24″	143°13′18″
	Demarcation Point (D-4)*		
83**	NE¼ SE¼ Sec. 3, T.6N., R.35E.	69°54′06″	143°21′18″
84	SW¼ NE¼ Sec. 23, T.7N., R.35E.	69°57′13″	143°19′08″
85	SW¼ NE¼ Sec. 26, T.7N., R.35E.	69°56′00″	143°19′12″
86	SE¼ SW¼ Sec. 12, T.7N., R.35E.	69°58′11″	143°17′08″
87	NE¼ NE¼ Sec. 13, T.7N., R.35E.	69°58′06″	143°16′00″
88	SW¼ NE¼ Sec. 13, T.7N., R.35E.	69°57′54″	143°16′30″
89	SE¼ NW¼ Sec. 13, T.7N., R.35E.	69°57′46″	143°17′32″
90	NW¼ NW¼ Sec. 24, T.7N., R.35E.	69°56′56″	143°18′10″
91	NW¼ NE¼ Sec. 4, T.7N., R.36E.	69°59′48″	143°09′06″
92	NW¼ SE¼ Sec. 4, T.7N., R.36E.	69°59′12″	143°09′06″
93	NW¼ NW¼ Sec. 3, T.7N., R.36E.	69°59′42″	143°08′08″
94	SE¼ NW¼ Sec. 16, T.6N., R.36E.	69°52′40″	143°10′05″
95	SE¼ SE¼ Sec. 20, T.6N., R.36E.	69°51′18″	143°10′54″
96	NE¼ NE¼ Sec. 6, T.5N., R.36E.	69°49′26″	143°13′20″
97	SW¼ SE¼ Sec. 32, T.6N., R.36E.	69°49′28″	143°11′40″
98	SW¼ SW¼ Sec. 33, T.6N., R.36E.	69°49′30″	143°10′06″
99	SE¼ SE¼ Sec. 34, T.8N., R.37E.	69°59′36″	142°50′36″

Appendix A.--Continued

Lake Number	Map Location	Latitude	Longitude
	Demarcation Point (D-4)*		
100	SW¼ NE¼ Sec. 8, T.7N., R.37E.	69°58'32"	142°56'32"
101	SE¼ NE¼ Sec. 3, T.7N., R.37E.	69°59'54"	142°50'36"
102	SW¼ SW¼ Sec. 15, T.7N., R.37E.	69°57'24"	142°52'42"
103	SE¼ SE¼ Sec. 11, T.7N., R.37E.	69°58'06"	142°49'06"
104	NE¼ SW¼ Sec. 14, T.7N., R.37E.	69°57'30"	142°49'53"
105	SW¼ SW¼ Sec. 20, T.6N., R.37E.	69°51'12"	142°57'48"
106	SW¼ NE¼ Sec. 32, T.6N., R.37E.	69°50'06"	142°57'00"
107	SE¼ SW¼ Sec. 28, T.6N., R.37E.	69°50'21"	142°54'40"
108	SW¼ NE¼ Sec. 33, T.6N., R.37E.	69°50'06"	142°53'48"
109	NW¼ SE¼ Sec. 3, T.6N., R.37E.	69°54'07"	142°51'35"
110	NW¼ SW¼ Sec. 27, T.6N., R.37E.	69°50'34"	142°52'45"
111	NE¼ NE¼ Sec. 2, T.6N., R.37E.	69°54'36"	142°48'30"
	Barter Island (A-3)*		
112	NW¼ SE¼ Sec. 25, T.8N., R.37E.	70°01'05"	142°46'35"
	Demarcation Point (D-3)*		
113	NE¼ NE¼ Sec. 1, T.7N., R.37E.	69°59'48"	142°45'48"
114	NE¼ SW¼ Sec. 36, T.7N., R.37E.	69°54'54"	142°46'54"
115	SW¼ SE¼ Sec. 13, T.7N., R.38E.	69°57'24"	142°31'35"
116	SW¼ SW¼ Sec. 3, T.6N., R.39E.	69°54'00"	142°23'07"
117	NW¼ NW¼ Sec. 10, T.6N., R.39E.	69°53'37"	142°22'41"
118	NE¼ SW¼ Sec. 14, T.6N., R.39E.	69.52'18"	142°19'48"
	Demarcation Point (D-2)*		
119	NW¼ NE¼ Sec. 33, T.6N., R.40E.	69°50'10"	142°09'20"

* Map names refer to U.S. Geological Survey 1:63,360 topographic maps.

** Lake has merged with a small lake in the northeast quarter and both lakes are now treated as a single lake.

Appendix B

Volume of water of lakes in the 1002 area
at various ice thicknesses

Appendix B.--Volume (acre-ft) of water of lakes in the 1002 area at various ice thicknesses. Average date of ice thickness is shown in parentheses.

Lake ID No	Surface Area (acres)	Max Depth (ft)	Ice Thickness (ft)								Fish Observed
			0	1 (Oct 31)	2 (Nov 13)	3 (Dec 11)	4 (Jan 4)	5 (Feb 20)	6 (Apr 5)	7 (Apr 16)[a]	
1[b]	33	1.5	57	24	0	0	0	0	0	0	NS[c]
2	131	13.1	912	784	668	564	465	372	284	204	NS
3[d]	0	0	0	0	0	0	0	0	0	0	NS
4	100	4.8	235	143	67	16	1	0	0	0	NS
5	58	6.8	279	222	167	117	72	34	9	0	NS
6	94	12.1	824	730	637	543	449	358	272	196	Yes
7	113	10.0	720	607	494	381	273	171	89	35	Yes
8	44	3.8	93	55	25	4	0	0	0	0	Yes
9	23	2.9	44	22	4	0	0	0	0	0	No
10	32	5.1	120	89	57	29	8	<1	0	0	No
11	22	4.3	75	53	31	11	<1	0	0	0	No
12	31	7.7	122	91	60	34	17	8	3	<1	Yes
13	40	3.1	85	45	11	<1	0	0	0	0	Yes
14	46	13.4	328	282	236	190	146	111	79	51	No
15	96	8.2	379	283	187	97	37	9	3	<1	No
16	257	3.8	668	427	221	67	0	0	0	0	NS
17	100	7.4	342	246	162	95	46	16	2	0	NS
18[b]	32	2.0	74	42	18	0	0	0	0	0	NS
19[b]	181	2.0	419	238	102	0	0	0	0	0	NS
20	81	9.2	457	377	301	230	167	110	59	18	NS
21	56	4.2	128	77	37	10	0	0	0	0	NS

Appendix B.-Continued

Lake ID No	Surface Area (acres)	Max Depth (ft)	Ice Thickness (ft)								Fish
			0	1 (Oct 31)	2 (Nov 13)	3 (Dec 11)	4 (Jan 4)	5 (Feb 20)	6 (Apr 5)	7 (Apr 16)	Observed
22	77	9.3	352	276	206	145	95	54	20	3	NS
23	35	10.7	240	206	173	142	112	85	61	40	NS
24	133	7.5	709	578	457	345	240	141	50	7	NS
25	131	2.3	182	67	3	0	0	0	0	0	Yes
26	64	8.3	321	258	199	144	94	50	13	0	NS
27	303	17.9	3212	2009	1706	1414	1138	878	639	432	Yes
28	79	3.4	216	141	72	14	0	0	0	0	NS
29	300	7.5	1190	914	688	497	321	162	36	<1	NS
30[b]	0	0	0	0	0	0	0	0	0	0	NS
31	104	8.7	557	452	348	249	161	90	39	10	Yes
32	34	10.9	208	174	142	112	84	59	36	18	NS
33	29	6.3	94	66	39	17	5	1	0	0	NS
34	1533	9.0	9285	7753	6220	4756	3416	2220	1169	340	NS
35	89	8.4	523	435	351	273	200	131	69	18	NS
36	1316	11.0	9198	7882	6565	5305	4138	3067	2097	1282	NS
37	342	8.3	1804	1462	1120	793	500	245	70	10	Yes
38	44	7.8	250	206	164	124	85	50	19	3	NS
39	58	4.9	224	167	112	62	23	0	0	0	NS
40	26	3.5	58	33	9	<1	0	0	0	0	No
41	30	5.9	116	85	56	28	2	0	0	0	NS
42	96	5.9	441	346	250	159	79	20	0	0	No
43[b]	0	0	0	0	0	0	0	0	0	0	NS
44	21	2.7	44	25	8	0	0	0	0	0	NS

Appendix B.-Continued

Lake ID No	Surface Area (acres)	Max Depth (ft)	Ice Thickness (ft) 0	1 (Oct 31)	2 (Nov 13)	3 (Dec 11)	4 (Jan 4)	5 (Feb 20)	6 (Apr 5)	7 (Apr 16)	Fish Observed
45	51	8.0	295	244	193	142	93	55	27	6	No
46	56	8.8	373	317	260	205	152	104	62	29	No
47	75	4.6	274	199	124	54	7	0	0	0	No
48	32	8.4	155	124	95	69	47	29	15	6	NS
49	53	5.7	195	142	92	48	17	2	0	0	No
50	36	7.2	181	145	111	78	48	23	7	0	NS
51	155	6.4	624	469	325	203	101	31	1	0	Yes
52	69	7.9	417	348	280	212	148	88	33	4	Yes
53	17	6.7	89	72	56	40	25	12	3	0	NS
54	83	4.1	263	180	97	28	<1	0	0	0	No
55	36	5.9	166	131	96	64	36	12	0	0	NS
56[b]	28	2.5	65	37	17	0	0	0	0	0	NS
57	59	6.9	304	246	189	136	87	43	13	0	NS
58	31	8.4	156	126	98	73	50	29	12	2	NS
59	24	10.5	117	94	72	53	37	23	11	3	NS
60	50	7.9	280	231	183	137	92	52	20	3	NS
61	24	7.8	125	102	80	59	40	23	8	1	NS
62	84	3.9	248	164	83	17	0	0	0	0	Yes
63	48	7.7	269	222	177	137	95	58	25	5	NS
64	128	8.1	766	638	510	382	259	151	66	13	Yes
65	87	8.6	477	390	302	215	141	89	49	16	Yes
66	43	6.5	193	150	109	70	34	7	0	0	NS

Appendix B.-Continued

Lake ID No	Surface Area (acres)	Max Depth (ft)	Ice Thickness (ft) 0	1 (Oct 31)	2 (Nov 13)	3 (Dec 11)	4 (Jan 4)	5 (Feb 20)	6 (Apr 5)	7 (Apr 16)	Fish Observed
67	190	3.6	530	340	168	21	0	0	0	0	Yes
68	65	8.9	393	327	262	197	137	82	38	8	Yes
69	33	8.1	173	140	109	80	52	28	7	0	NS
70[b]	20	2.0	46	26	11	0	0	0	0	0	NS
71	43	8.2	190	147	106	69	40	19	4	0	NS
72	33	9.1	68	41	22	12	7	4	2	1	NS
73	168	8.6	788	620	453	299	174	76	25	7	Yes
74	69	11.0	429	361	292	223	158	98	46	11	Yes
75	102	8.7	679	576	474	371	270	174	88	23	Yes
76	63	11.6	454	392	329	267	206	149	98	53	Yes
77	26	8.7	105	80	56	35	19	8	2	0	NS
78	36	8.7	149	113	79	49	24	9	2	1	NS
79	97	3.3	216	119	31	<1	0	0	0	0	Yes
80	164	8.5	1045	881	717	558	412	280	159	53	Yes
81	41	6.7	155	115	77	44	19	5	1	0	NS
82	32	5.5	96	65	35	12	2	0	0	0	NS
83	32	7.9	184	153	122	92	64	39	16	3	NS
84	46	7.5	262	215	169	127	90	57	28	4	Yes
85	31	8.2	140	109	80	53	28	8	1	0	NS
86	41	7.1	226	185	144	106	70	36	10	<1	Yes
87	33	6.8	128	96	66	41	19	4	0	0	NS
88	27	5.6	75	49	26	10	2	0	0	0	NS
89	60	7.8	375	315	254	196	141	91	48	10	Yes

Appendix B.-Continued

Lake ID No	Surface Area (acres)	Max Depth (ft)	Ice Thickness (ft) 0	1 (Oct 31)	2 (Nov 13)	3 (Dec 11)	4 (Jan 4)	5 (Feb 20)	6 (Apr 5)	7 (Apr 16)	Fish Observed
90	36	6.9	187	151	115	81	50	24	5	0	Yes
91[b]	77	1.5	77	33	0	0	0	0	0	0	NS
92	68	3.6	148	81	20	0	0	0	0	0	NS
93	58	8.2	261	203	145	92	50	20	6	1	Yes
94	181	7.7	1003	823	642	475	330	200	79	8	No
95	29	3.5	79	50	24	4	0	0	0	0	NS
96	89	5.9	284	195	112	49	15	2	0	0	Yes
97	99	7.8	610	511	412	313	218	131	56	7	Yes
98	33	8.3	165	132	101	71	44	20	6	1	NS
99	38	7.9	195	157	121	88	58	32	12	2	NS
100	43	1.7	25	2	0	0	0	0	0	0	No
101	29	5.7	130	100	73	47	24	6	0	0	NS
102	30	7.4	131	101	73	47	23	7	1	0	NS
103	35	6.8	147	113	81	52	29	13	4	0	NS
104	50	6.2	226	176	127	80	41	11	<1	0	No
105	34	5.8	112	81	53	29	9	2	0	0	NS
106	36	5.7	84	52	26	10	2	0	0	0	NS
107	55	6.8	207	152	102	62	33	11	1	0	No
108[b]	20	2.0	46	26	11	0	0	0	0	0	NS
109	142	9.2	952	810	669	527	390	262	147	49	Yes
110	54	4.8	179	125	71	24	<1	0	0	0	No
111	25	4.8	76	52	29	9	1	0	0	0	NS
112	88	3.3	189	102	34	2	0	0	0	0	No

Appendix B.-Continued

Lake ID No	Surface Area (acres)	Max Depth (ft)	Ice Thickness (ft) 0	1 (Oct 31)	2 (Nov 13)	3 (Dec 11)	4 (Jan 4)	5 (Feb 20)	6 (Apr 5)	7 (Apr 16)	Fish Observed
113	26	3.8	75	50	27	8	0	0	0	0	NS
114[b]	0	0	0	0	0	0	0	0	0	0	NS
115	41	7.5	221	180	139	99	64	33	11	<1	Yes
116	45	7.9	148	103	58	22	6	3	1	<1	Yes
117	25	3.1	48	24	6	<1	0	0	0	0	Yes
118	18	2.7	32	15	4	0	0	0	0	0	NS
119	68	24.8	819	751	683	615	548	484	422	363	Yes
Total			55,379	43,959	33,962	25,061	17,755	11,702	6,797	3,366	

a. Seven feet of ice was reported only during one year of record.

b. Lake was too shallow for fathometer readings. Volumes are estimates based on surface area from U.S.G.S. topographic maps and maximum depth estimates.

c. Lake was not sampled for fish.

d. Lake is directly connected to the Beaufort Sea.

From: Wendy Loya
To: Joanna Fox; Hollis Twitchell; Steve Berendzen; Christopher Putnam; Joshua Rose; Sarah Conn; Stephanie Brady; John Trawicki; John Martin
Subject: RE: UPDATED: 1002 Actions for Cumulative Effects Analysis
Date: Monday, July 16, 2018 1:02:37 PM

We have been having internet trouble in Anchorage, if we can't connect by vidyo, use the following call in info:
Instant Meeting Audio # [redacted]

But let's try vidyo to start

Dr. Wendy M. Loya,
Arctic Program Coordinator
Office of Science Applications, US Fish and Wildlife Service
Anchorage, Alaska
907.786.3532 (office)
907.277.2942 (mobile)

-----Original Appointment-----
From: wendy_loya@fws.gov <wendy_loya@fws.gov>
Sent: None
To: Wendy Loya; Joanna Fox; Hollis Twitchell; Steve Berendzen; Christopher Putnam; Joshua Rose; Sarah Conn; Stephanie Brady; John Trawicki; John Martin
Subject: UPDATED: 1002 Actions for Cumulative Effects Analysis
When: Monday, July 16, 2018 11:00 AM-12:00 PM (UTC-09:00) Alaska.
Where: FWS-FW7 NWRS Conference Room/Regional Office or Vidyo to RO Refuges Conference Room

Dear Colleagues,

We would like your input on any reasonably foreseeable future actions that the Service will request be included in the cumulative impacts analysis.

A reasonably foreseeable future action is defined as a project for which there is an existing proposal, a project currently in the NEPA process, or a project to which a commitment of resources (such as funding) has been made.

I will host a discussion on Monday at 11 am, or you can send your input to me by COB on Monday July 16th via this google doc:
https://docs.google.com/spreadsheets/d/1SH5Sqiv8aJb6bjLZFAjw9O2nSdk3zjuaNxfOg_qeAq0/edit?usp=sharing

Thank you,
Wendy

From: Greg Siekaniec
To: Wendy Loya; Mary Colligan; Berendzen, Steve; Angela Matz; Johnson, Carl; Catherine Collins; Christopher Latty; Christopher Putnam; Doug Damberg; edward_deClava@fws.gov; Hollis Twitchell; Jennifer Reed; Joanna Fox; John Brewer; Martin, John; John Trawicki; Joshua Ream; Joshua Rose; Murphy, Karen; Kevin Doherty; Lynnda Kahn; Ellis, Mitch; Patrick O"Dell; Paul Leonard; Peter Butteri; Randy Brown; Kaye, Roger; Ryan Wilson; Boario, Sara; Sarah Conn; Lor, Socheata; Stephanie Brady; Stephen Arthur; Susan LaKomski; Ted Swem; Tim Allen; Hopkins, Todd; Fischbach, Tracy
Subject: Thank You
Date: Tuesday, July 17, 2018 7:35:47 AM

Dear Arctic Refuge Interdisciplinary Team,

Last week we attended the Arctic Refuge Coastal Plain Leasing EIS workshop hosted by BLM for Cooperating Agencies. The format was similar to the internal meeting held in Fairbanks over two days in June, and included partners from State of Alaska, the Native Villages of Kaktovik, Venetie, and Arctic Village, and the North Slope Borough. As you know Mary Colligan, Steve Berendzen and Wendy Loya represented your planning thoughts and ideas during the workshop. They were able to share the results of the hard work you all have done over the last month to envision a path that acknowledges all of the refuge purposes including the recent addition of an oil and gas program. In addition, Karen and I were invited to the BLM office Thursday afternoon for a brief on the outcome of the workshop. We were very pleased and encouraged to see the original purposes of wildlife, subsistence, waters, wilderness, and recreation represented very well in the alternatives. It is too early to know how the final alternatives will reflect the range of conservation values we want ensure for future generations but your efforts have set the stage.

Compliments have been forthcoming from BLM and others on how well the Service was prepared for presenting data, ideas, and dialogue around the issues. Your toils provided leadership to the entire planning group of cooperating organizations. You all contributed to empowering our representatives with the information needed to provide the scientific and conservation basis for requesting stipulations and best management strategies that will reduce impacts to high value wildlife habitats and important uses. Other cooperating organizations expressed gratitude that we had the foresight to bring forward data and information that could help inform a reasonable range of alternatives in this difficult and accelerated decision-making process.

Again, thank you for all the time and hard work over these past few months. Please know that your efforts are valued and you are making a positive impact as we stay the course as a Cooperating Agency on the Draft Leasing EIS and Seismic EA.

Greg

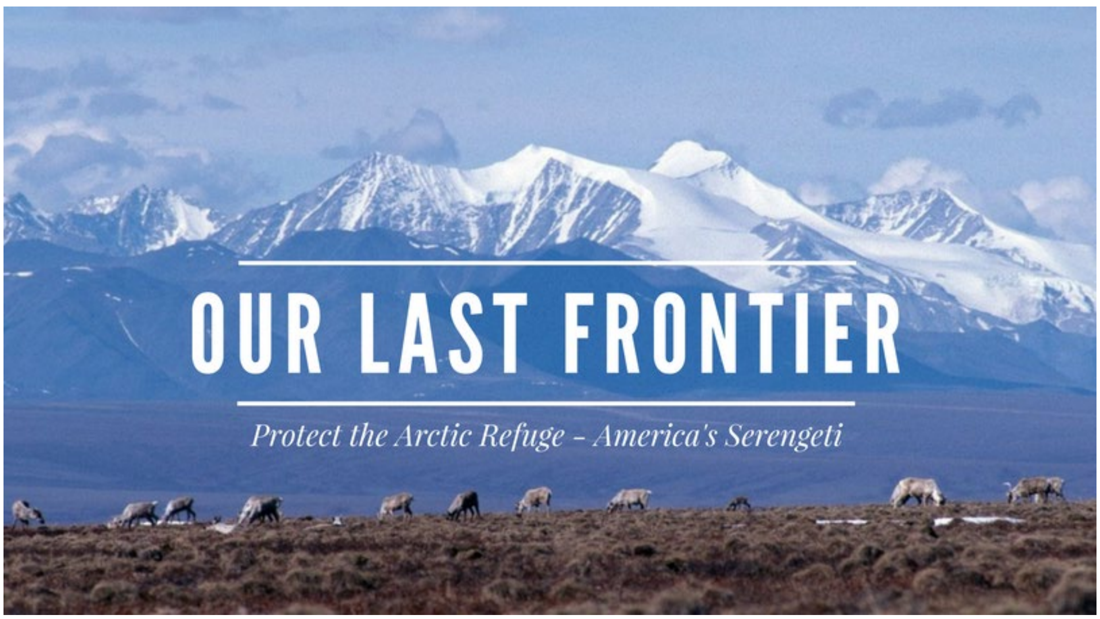
From: Desiree Sorenson-Groves, National Wildlife Refuge Association
To: Hollis_Twitchell@fws.gov
Subject: [EXTERNAL] We aren’t going to let them get away with this.
Date: Tuesday, July 24, 2018 6:47:01 AM

View in browser

Forward to a Friend

We've never been this close to opening up the Arctic Refuge to drilling. Help us with an urgent gift to protect your Arctic Refuge!

Protect the Arctic Refuge >>



Dear Hollis,

The news is out. The Interior Department is bending their own rules to fast track review of the impact of leasing the Arctic National Wildlife Refuge for drilling.

Why would they do it? Because its the only way to get their leases sold by next summer. They are throwing out decades of established practice and skipping over sound science to rush this boondoggle to the auction.

Not on our watch. To save the Arctic from the drill, we can’t let the administration get away with their ploy. We need to mobilize to defend our refuges. Will you please help with your gift now?

Geoff Haskett, National Wildlife Refuge Association President, has been working the media and editorial circuit to get our message out. Last week he said it best in the Washington Post when he said,

“They’re going to make mistakes because they’re moving so fast. They’re certainly not

going to get much input on this."

Just last night, The Hill published an Op-Ed where Geoff carefully explains how the Trump administration is gutting the bedrock of US environmental law. Geoff summed it up when he wrote,

"The government's reckless plan for oil drilling on the coastal plain of the Arctic Refuge is imperiling wolves, threatened polar bears, more than 200 bird species, and one of our bedrock environmental laws."

I am sorry to tell you - he's right. They don't want to hear from those of us who put the wildlife values of the Arctic National Wildlife Refuge over the sale of drilling leases. He is also right that they are going to make mistakes - and we are going to catch them - but we need your help.

The threat is real. We've been fighting to defend refuges for more than 40 years, and never before have we felt this sort of pressure. Never before has the need to your support been so high. Please consider donating today, so we can continue the fight to protect the Arctic National Wildlife Refuge.

Thank you -

Desirée Sorenson-Groves
Vice President, Government Affairs

National Wildlife Refuge Association
1001 Connecticut Ave. NW, Suite 905
Washington, D.C. 20036
Phone: 202-417-3803

From:	Todd Hopkins
To:	Wendy Loya
Cc:	bud_cribley@fws.gov; richard_lanctot@fws.gov; Diane Granfors; Margaret Perdue; Powers, Elizabeth; Guyer, Scott; angela_matz@fws.gov; carl_johnson@fws.gov; catherine_collins@fws.gov; christopher_latty@fws.gov; christopher_putnam@fws.gov; Doug Damberg; edward_decleva@fws.gov; Hollis Twitchell; Jennifer Reed; Joanna Fox; john_brewer@fws.gov; John Martin; John Trawicki; joshua_ream@fws.gov; joshua_rose@fws.gov; Karen Murphy; Kevin Doherty; lynnda_kahn@fws.gov; Mary Colligan; Mitch Ellis; patrick_odell@fws.gov; Paul Leonard; peter_butteri@fws.gov; Randy Brown; Roger Kaye; ryan_r_wilson@fws.gov; sara_boario@fws.gov; Sarah Conn; Socheata Lor; Brady, Stephanie; stephen_arthur@fws.gov; Steve Berendzen; susan_lakomski@fws.gov; ted_swem@fws.gov; tim_allen@fws.gov; Tracy Fischbach; karen_clark@fws.gov; Greg Siekaniec
Subject:	Re: While Wendy is away July 25-Aug 8th...
Date:	Tuesday, July 24, 2018 7:14:40 PM

Have a great trip!

==================

Todd E. Hopkins, Ph.D.

Acting Chief (6/11 – 8/3)

Natural Resources Division

National Wildlife Refuge System

U.S. Fish & Wildlife Service

1011 East Tudor Road

Anchorage, AK 99503

Off: (907) 786-3584

Cell: (772) 584-2594

On Tue, Jul 24, 2018 at 12:35 PM Wendy Loya <wendy_loya@fws.gov> wrote:

> Dear 1002 Team,
>
> I will be out of the office July 25-Aug 8^{th}, heading to the place we have been thinking about

24-7 since January (packrafting in the Arctic Refuge).

The POCs have my satellite texting device and I welcome questions to keep things rolling along towards the Leasing EIS and the Seismic EA. I plan to work in Fairbanks on Aug 9th when we expect to see the Draft Leasing EIS for review, and will send out info as quickly as I can on how our review will proceed. If there is a delay in receiving it from BLM, we will let you know ASAP.

A reminder about who are the POCs if you have any questions in the next two weeks. They will have copies of the current FWS recommended Stipulations and BMPs we developed if you need them for your resource. Please keep your POC in the loop on any correspondence you have with BLM or their contractors so we can insure we are consistent and up to date on all info:

Steve Berendzen will be the Regional POC while I am away. If documents need review, he will work with ARDs to move them through the process 907-456-0253

Joanna Fox (co-POC for Arctic Refuge; cc her with any correspondence to Steve)

John Trawicki (Leasing EIS POC for NWRS)

Drew Crane (Leasing EIS POC for FES)

Josh Rose (Seismic EA POC)

Sarah Conn (Seismic EA POC for FES)

Paul Leonard (All things GIS, including spatial representation of Stips)

Thank you for your hard work to help us bring the best science forward for the Arctic Refuge. I'll be thinking of you all (more than I should, I am sure) while I am looking out on the amazing Arctic ☺

Wendy

Dr. Wendy M. Loya,

Arctic Program Coordinator

Office of Science Applications, US Fish and Wildlife Service

Anchorage, Alaska

907.786.3532 (office)

907.277.2942 (mobile)

From: Wendy Loya
To: Paul Leonard; John Trawick ; Randy Brown; Jennifer Reed; Sarah Conn; Hollis Twitchell; Joanna Fox; Pe er Butteri; Gilbert Caste lanos; Lynnda Kahn; Drew Crane; Christopher Latty; Patrick O Dell; Carl Johnson; John Martin; Stephen Arthur; Joshua Ream; Steve Berendzen; Er c Tay or; Catherine Collins; Susan LaKomski; Roger Kaye; Edward Decleva; Char es Hami ton; T m Al en; Ryan Wi son; Ted S em; Josh a Rose
Subject: RE: Save the Dates: Rev ew 1002 Leasing DEIS
Date: Thursday August 9 2018 9:54:09 AM

Good morning 1002 team!

BLM has just delivered the draft of the EIS for the Arctic Refuge Coastal Plain to our inbox and I am working with the POCs to determine the best most efficient use of our time in doing the review. We will send out the documents and comment form in a few hours with guidance.

More soon!
Wendy

Dr. Wendy M. Loya
Arctic Program Coordinator
Office of Science Applications US Fish and W ldlife Service
Anchorage Alaska
907.786.3532 (o fice)
907.277.2942 (mobile)

-----Original Appointment-----
From: wendy loya@fws.gov <wendy loya@fws.gov>
Sent: Thursday July 5 2018 5:01 PM
To: wendy loya@fws.gov; Paul Leonard; Trawicki John; Brown Randy; Jennifer Reed; sarah conn@fws.gov; Hollis Twitchell; Joanna Fox; Peter Butteri; Gilbert Castellanos; Kahn Lynnda; drew crane@fws.gov; Christopher Latty; Patrick O'Dell; carl johnson@fws.gov; john w martin@fws.gov; Stephen Arthur; Joshua Ream; steve berendzen@fws.gov; eric taylor@fws.gov; Catherine Collins; Susan LaKomski; Kaye Roger; Edward Decleva; Charles Hamilton; Tim Allen; Ryan Wilson; Ted Swem; Joshua Rose
Subject: Save the Dates: Review 1002 Leasing DEIS
When: Thursday August 9 2018 8:00 AM to Monday August 13 2018 4:00 PM (UTC-09:00) Alaska.
Where:
Importance: High

Dear FWS Arctic Refuge Coastal Plain Leasing EIS “Interdisciplinary Team” member: Please save the dates of Aug 9-13th for your review of the Draft EIS. The window is very narrow, so we will have an organized plan for review and collating comments so we can best use your area-of-expertise in our Cooperating Agency review process. More details to come as we work with BLM on how to best provide feedback. Please advise Wendy Loya wendy loya@fws.gov and your POC below if you expect to be unavailable during this time. FES: Drew Crane Mig Birds: Eric Taylor Arctic Refuge: Steve Berendzen NWRS: John Trawicki OSM: contact Wendy Thank you, Wendy Dr. Wendy M. Loya, Arctic Program Coordinator Office of Science Applications, US Fish and Wildlife Service Anchorage, Alaska 907.786.3532 (office) 907.277.2942 (mobile) -::~:~::~::~:~::- Please do not edit this section of the description. This event has a Google Hangouts video call. Join: https://hangouts.google.com/hangouts/ b5 - CIP [redacted]
-::~:~::~::~:~::-

From: john_trawicki@fws.gov
To: Paul Leonard; Randy Brown; Jennifer Reed; Sarah Conn; Hollis Twitchell; Joanna Fox; Peter Butteri; Lynnda Kahn; Drew Crane; Christopher Latty; Patrick O"Dell; Carl Johnson; John Martin; Stephen Arthur; Joshua Ream; Steve Berendzen; Eric Taylor; Catherine Collins; Susan LaKomski; Roger Kaye; Edward Decleva; Charles Hamilton; Tim Allen; Ryan Wilson; Ted Swem; Joshua Rose; John Martin; Mary Colligan; Mitch Ellis; "jorgenson[redacted]"
Subject: FW: 1002 Team Meeting for Draft EIS Review

Please join in Anchorage or Fairbanks Refuges Conference Room or by Vidyo to FW7 NWRS RO Conference Room for an intro and overview of the Coastal Plain DEIS review process. Supporting emails to arrive shortly. The POCs and I will be available to discuss with those who cannot attend. Thank you!

Wendy
Dr. Wendy M. Loya,
Arctic Program Coordinator
Office of Science Applications, US Fish and Wildlife Service
Anchorage, Alaska
907.786.3532 (office)
907.277.2942 (mobile)

To discuss review of draft EIS [redacted] -::~:~::~::~:~::-
Please do not edit this section of the description. This event has a Google Hangouts video call. Join:
https://hangouts.google.com/[redacted]
::~:~::~::~:~::-